

1 / 35

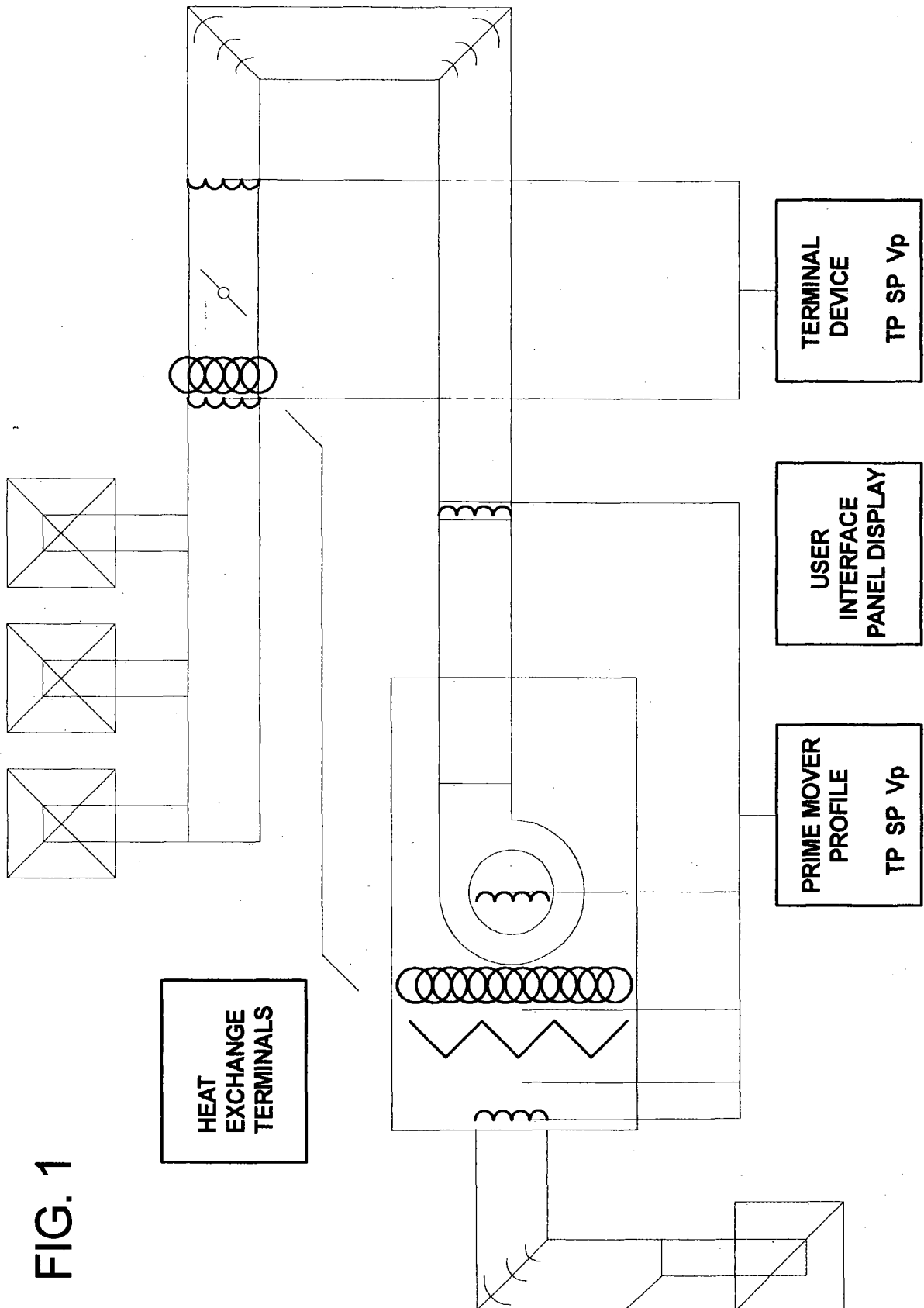


FIG. 2

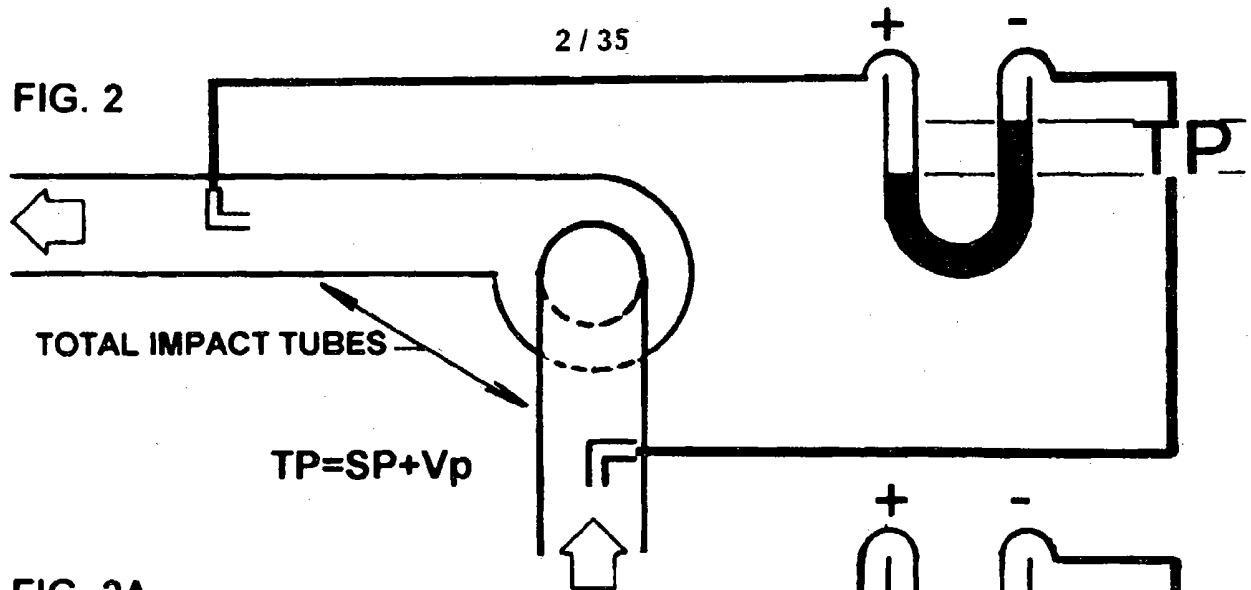


FIG. 2A

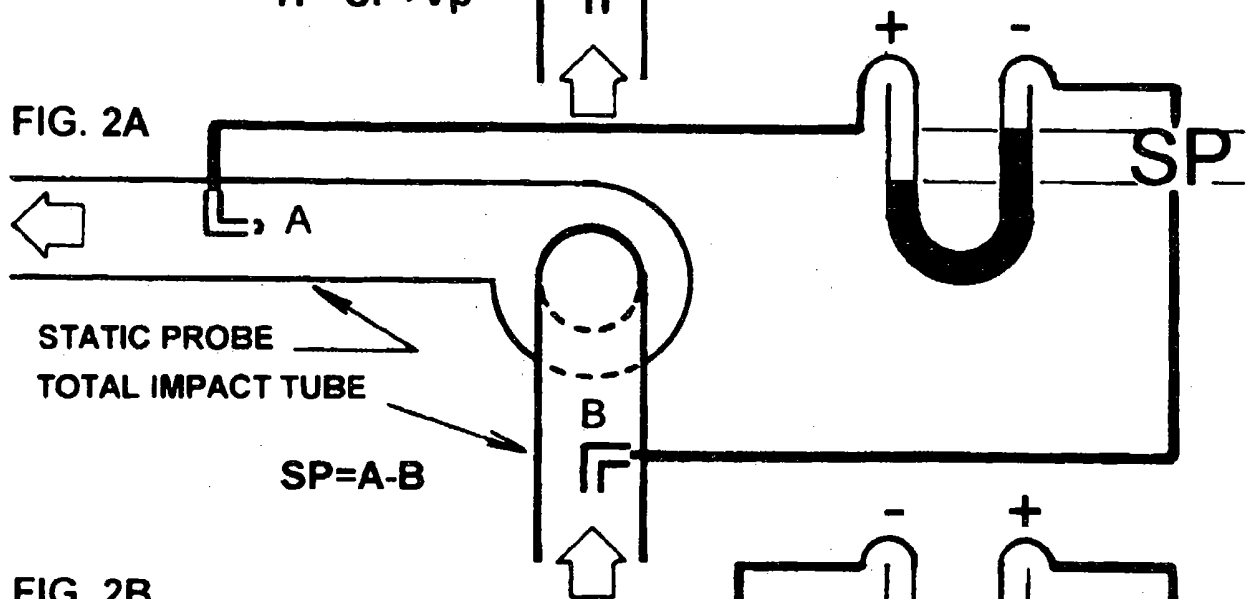
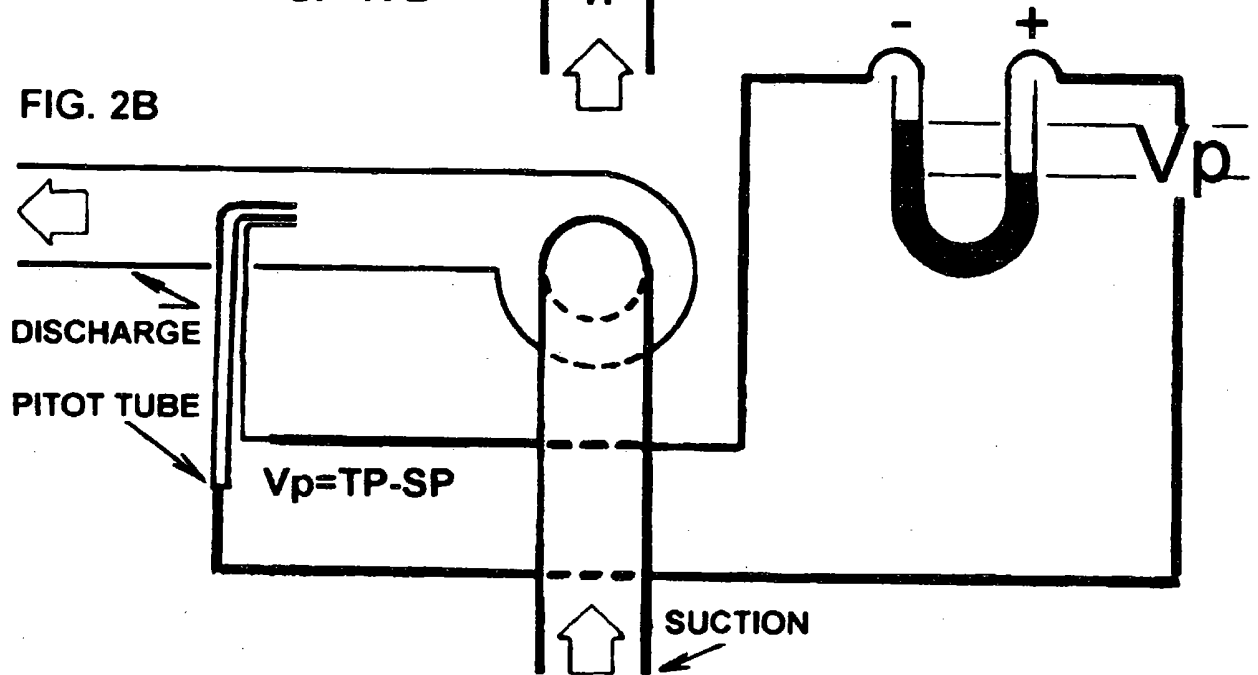


FIG. 2B



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FIG. 3

TYPICAL DRAW-THRU UNIT

OUTDOOR
AIR

MIXING
BOX

RETURN AIR

FILTER
SECTION

COIL SECTION

BLOWER SECTION

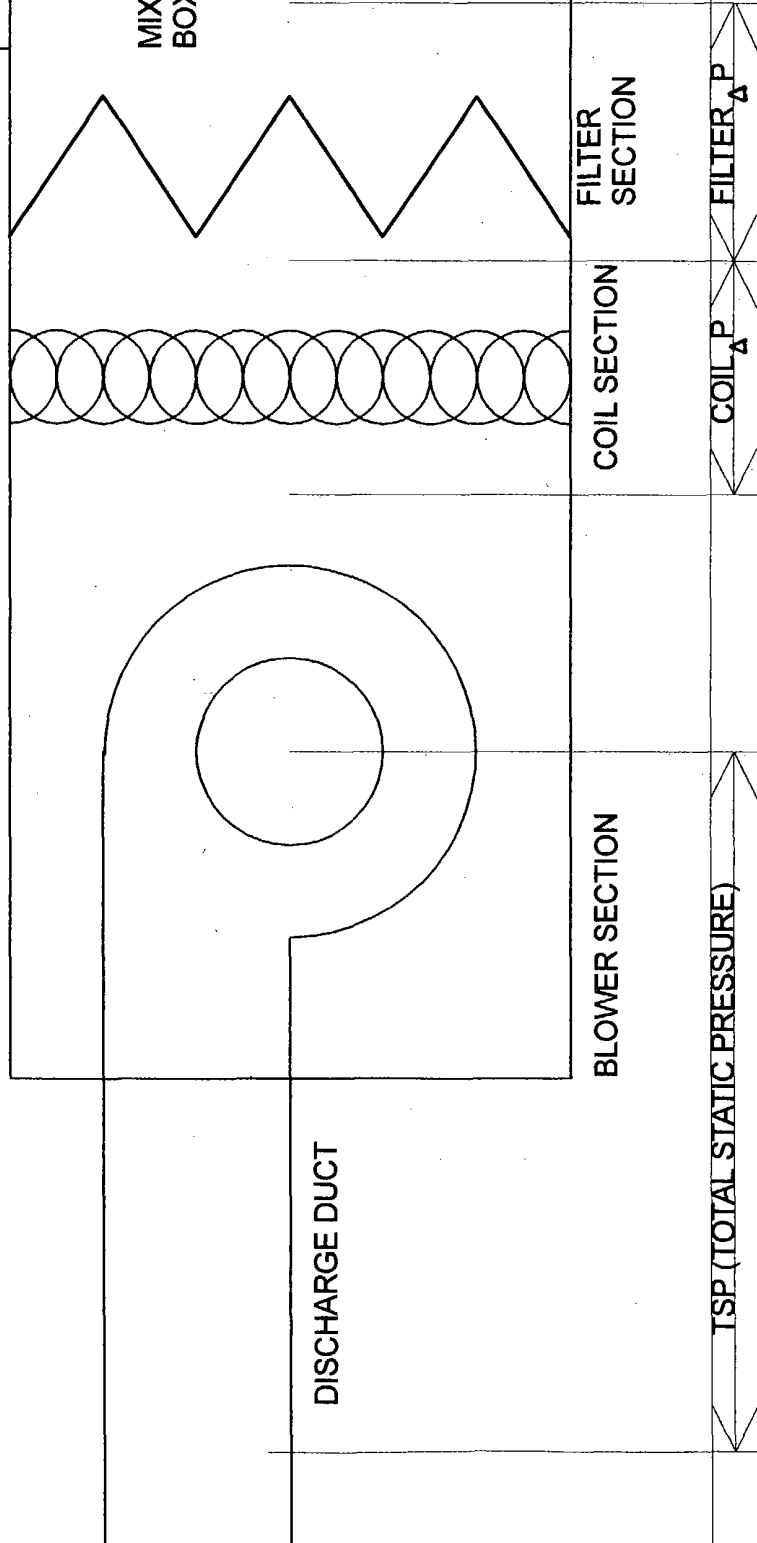
DISCHARGE DUCT

FILTER ΔP

COIL ΔP

TSP (TOTAL STATIC PRESSURE)

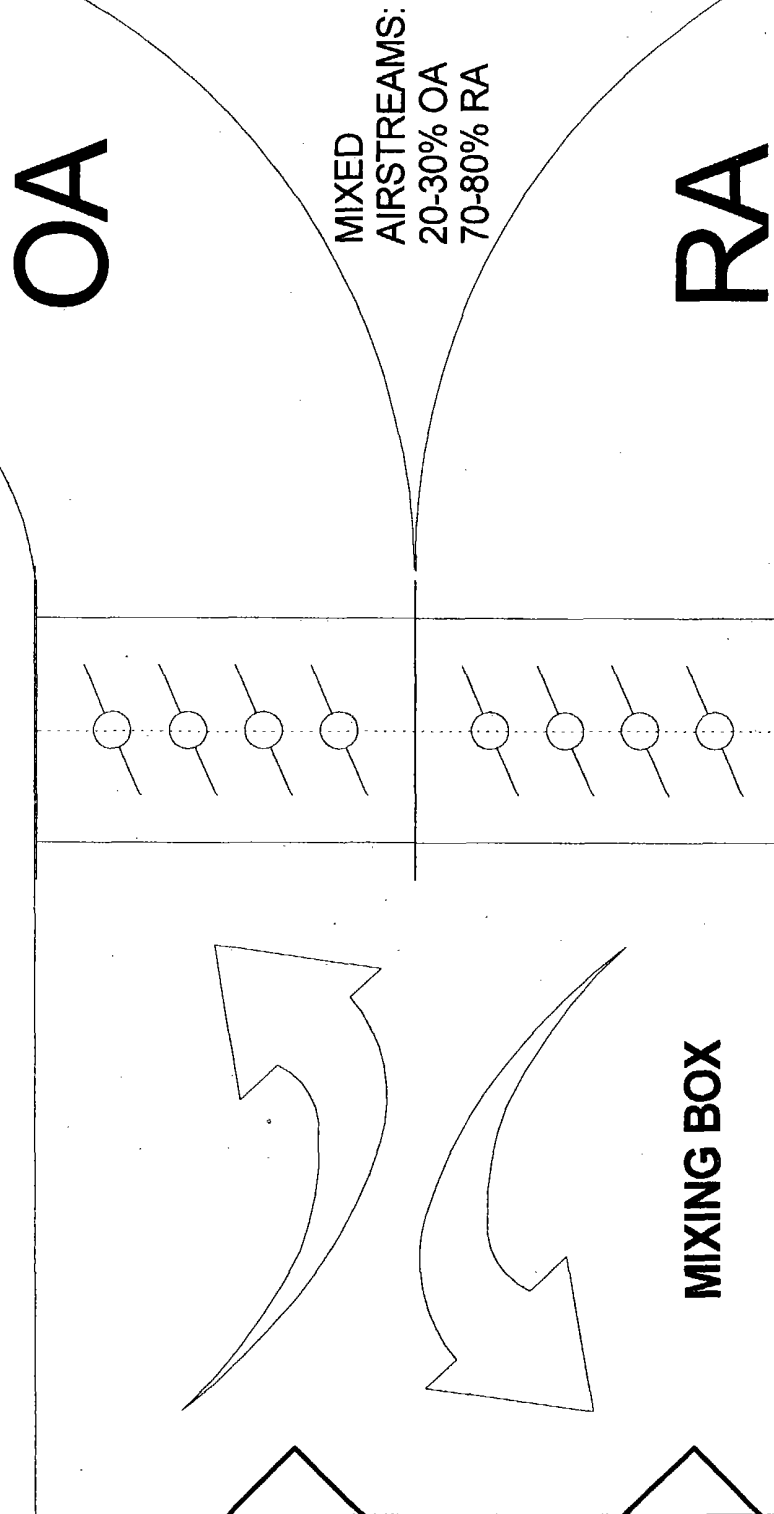
TESP (TOTAL EXTERNAL STATIC PRESSURE)



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FIG. 4

NORMAL MODE OPERATION



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FIG. 4A

SMOKE MODE OPERATION

OA

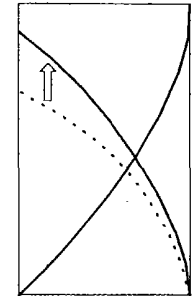
AIRSTREAM:
100% OA

RA

RA DAMPER FULLY CLOSED

100% OA

MIXING BOX



SP Vp TP
TOTAL SYS. CURVE
AND OP IS ALTERED
BY CHANGE OF MODE,
DAMPER POSITIONS

TRADITIONAL FAN PERFORMANCE CURVES

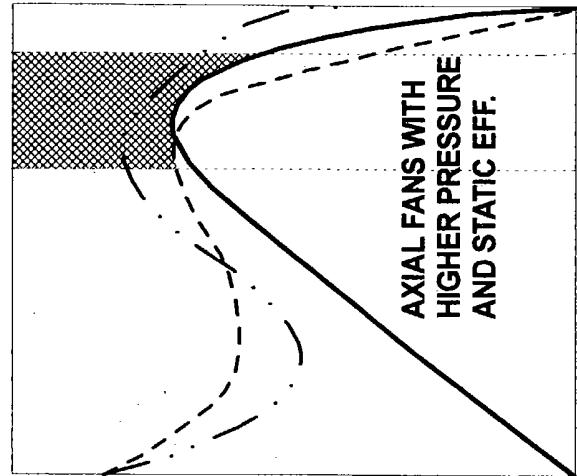
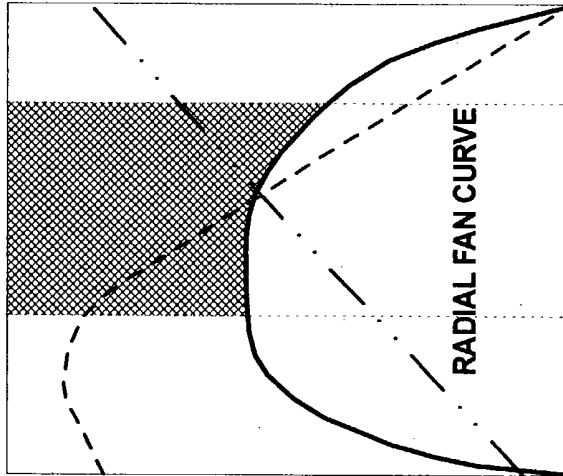
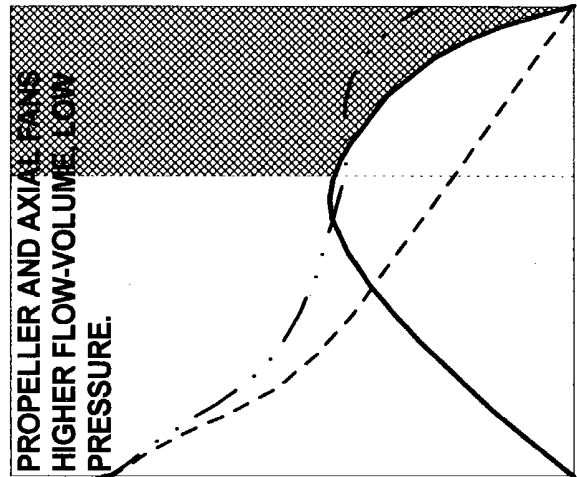
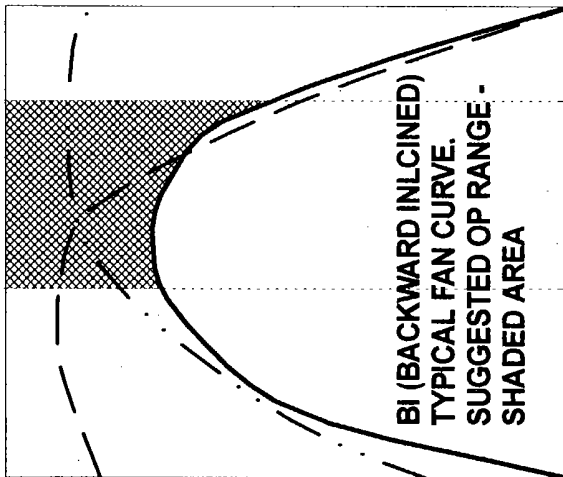
FIG. 5

SP _____
 STATIC EFF. _____
 BHP _____

SP CURVE OCCURS AT
 SPECIFIED FRPM AND IS THE
 BASIS FOR DETERMINING OP
 WHEN PLOTTED AGAINST
 A GIVEN SYSTEM.

NEW METHOD SHALL FURTHER
 BREAK DOWN THIS CURVE INTO
 THE THREE KEY COMPONENTS
 FOR ANALYSIS: SP, V_p , TP

THIS WILL ALSO PROVIDE
 THE BEST MEANS OF PAIRING A
 PRIME MOVER AND ITS
 SYSTEM FOR EQUIPMENT
 SELECTION.



INV. TITLE: FULLY ARTICULATED AND COMPREHENSIVE AIR AND FLUID DISTRIBUTION,
METERING, AND CONTROL METHOD AND APPARATUS FOR PRIMARY MOVERS, HEAT
EXCHANGERS, AND TERMINAL FLOW DEVICES.

INV. NAME: DANIEL STANIMIROVIC

PHONE: 954-454-3550

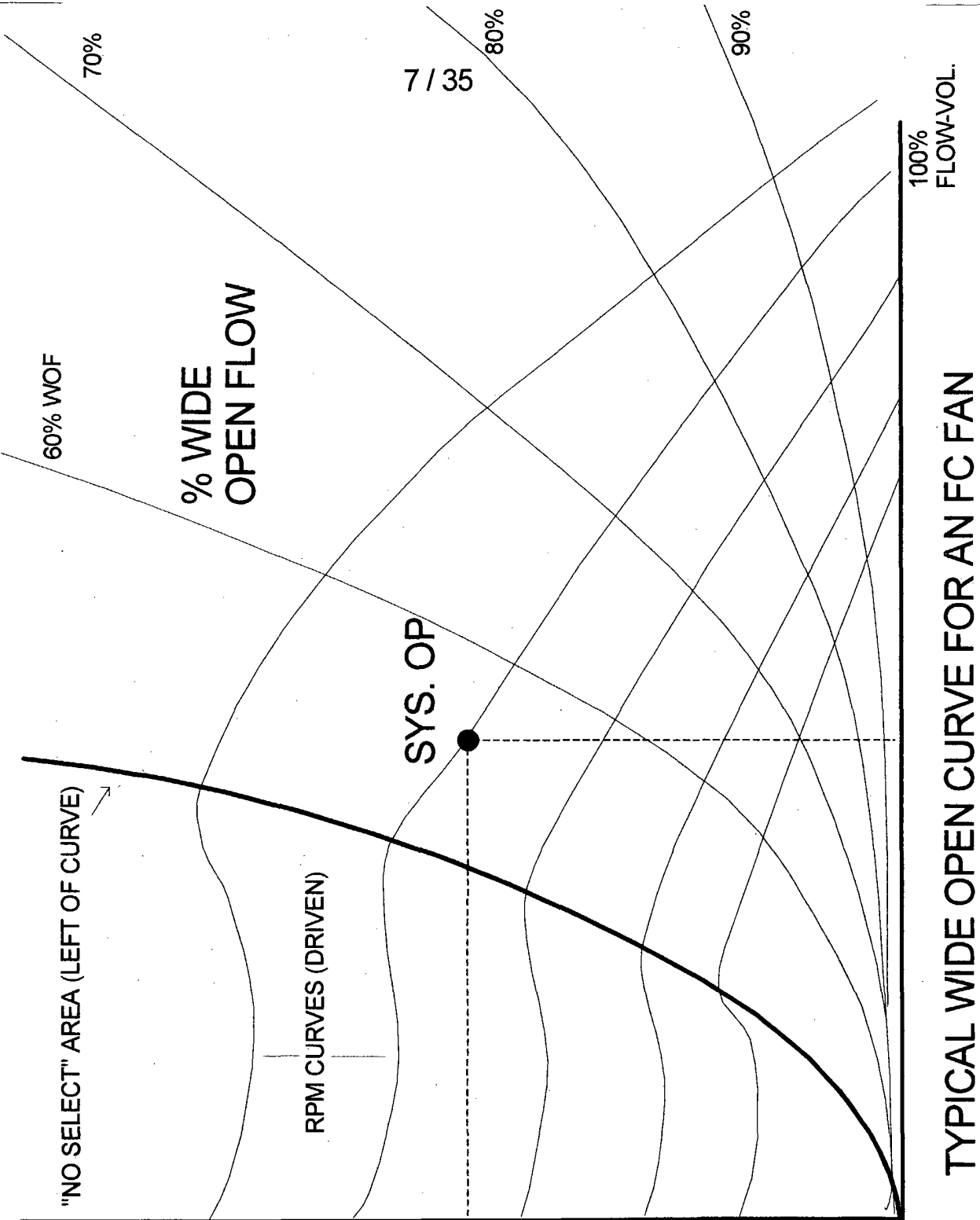


FIG. 6

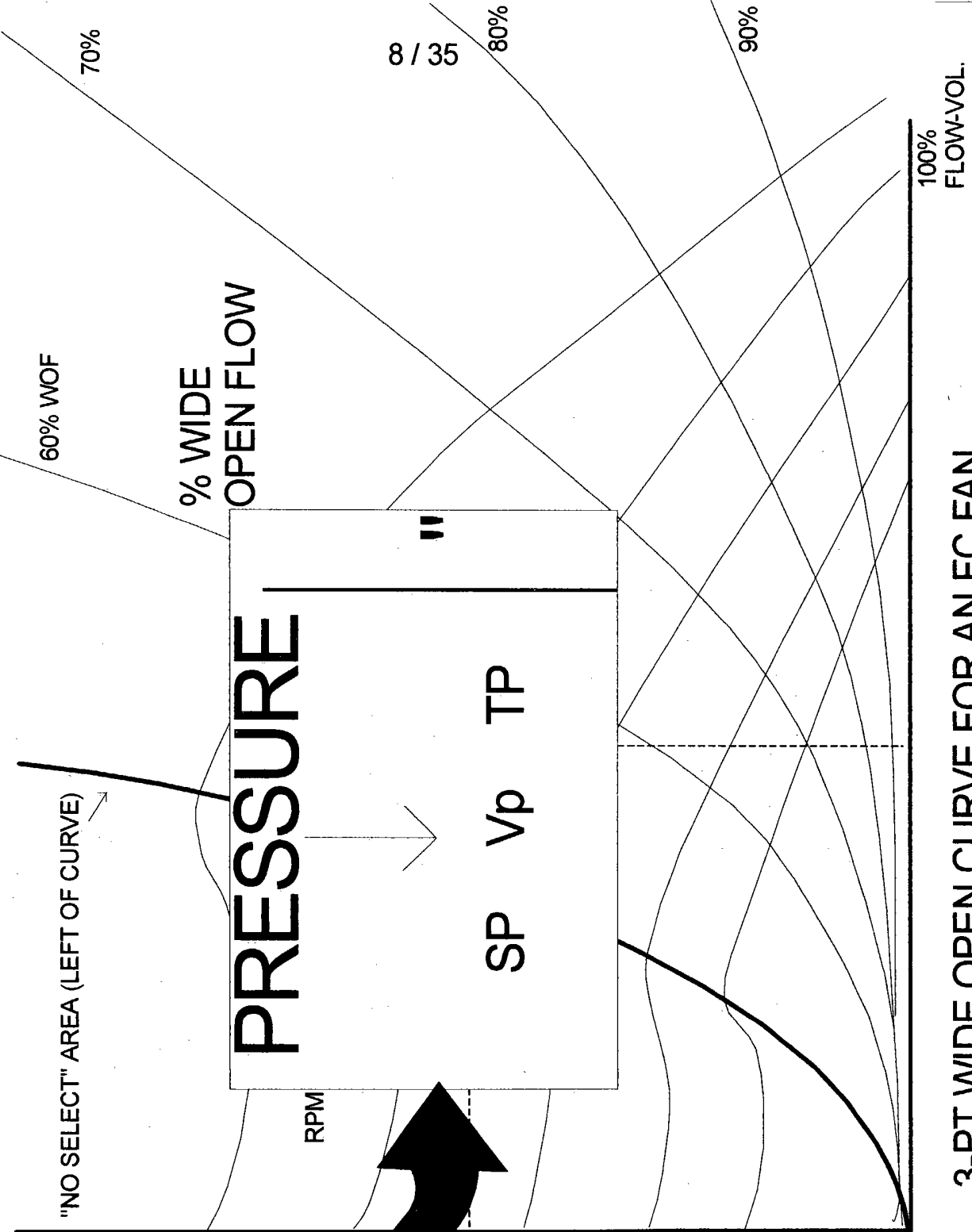
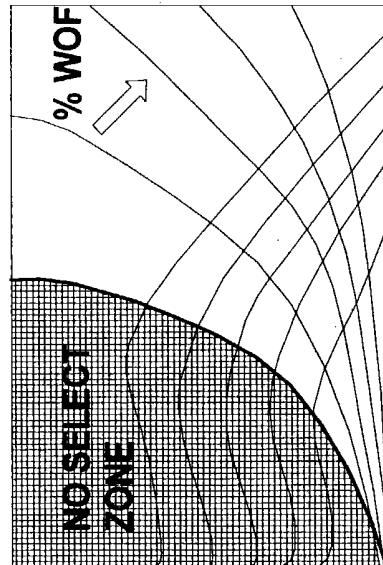


FIG. 6A

WIDE OPEN AND SYSTEM CURVES JUXTAPOSED

FIG. 7

KNOWN PRIME MOVER WOC



100%
FLOW-VOL.

UNKNOWN TOTAL SYSTEM ATTACHED

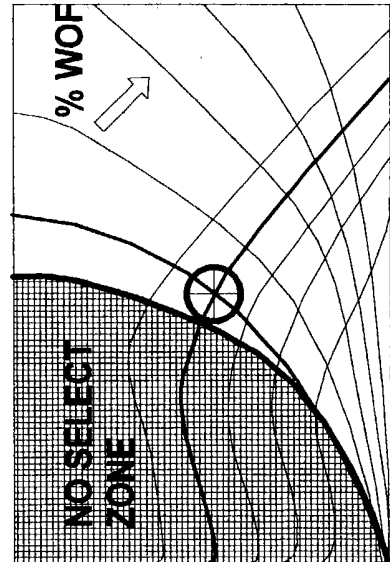
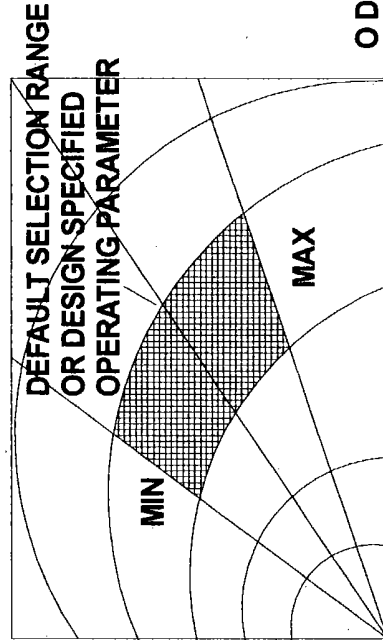


FIG. 7A

TERMINAL OR IN-LINE DEVICE WOC

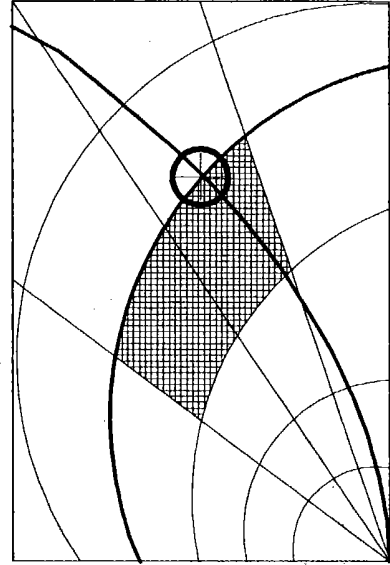


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0 DEGREES OR
100% OPEN

UNKNOWN SUB-SYSTEM ATTACHED



PRIMARY OR TERMINAL HEAT EXCHANGE

FIG. 8

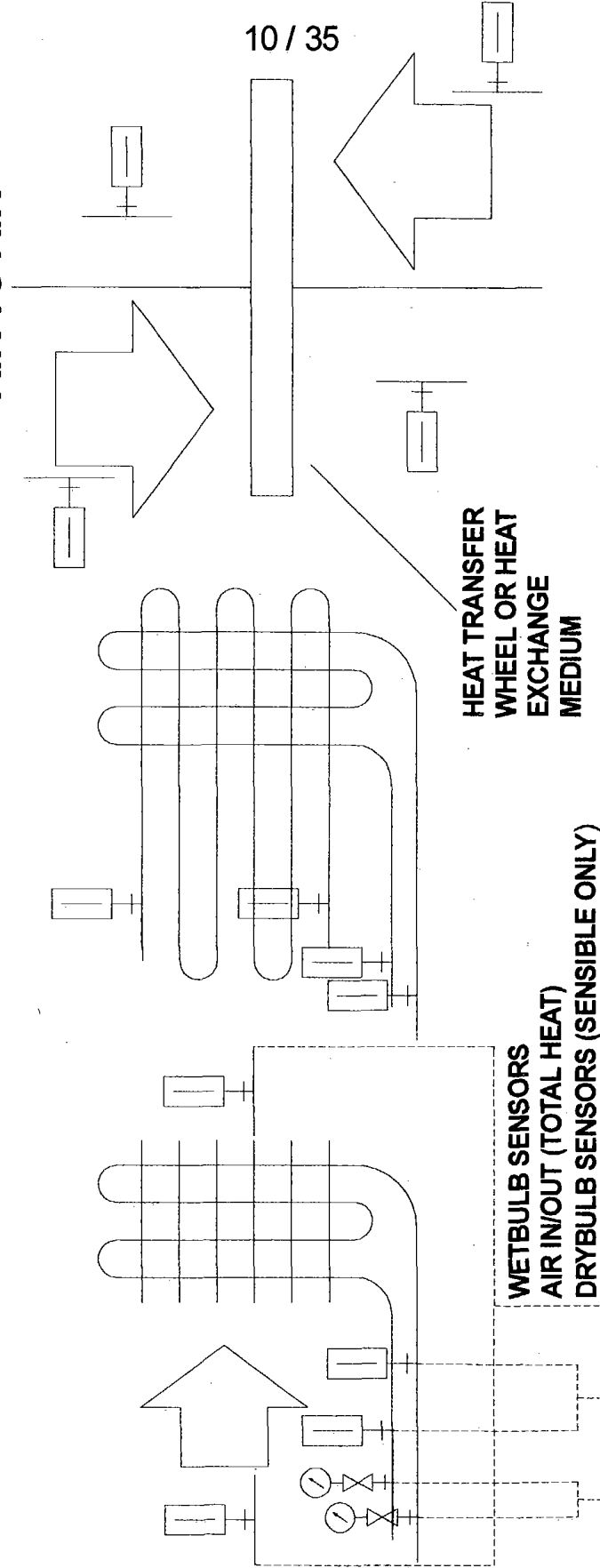
AIR TO WATER

FIG. 8A

WATER TO WATER

FIG. 8B

AIR TO AIR



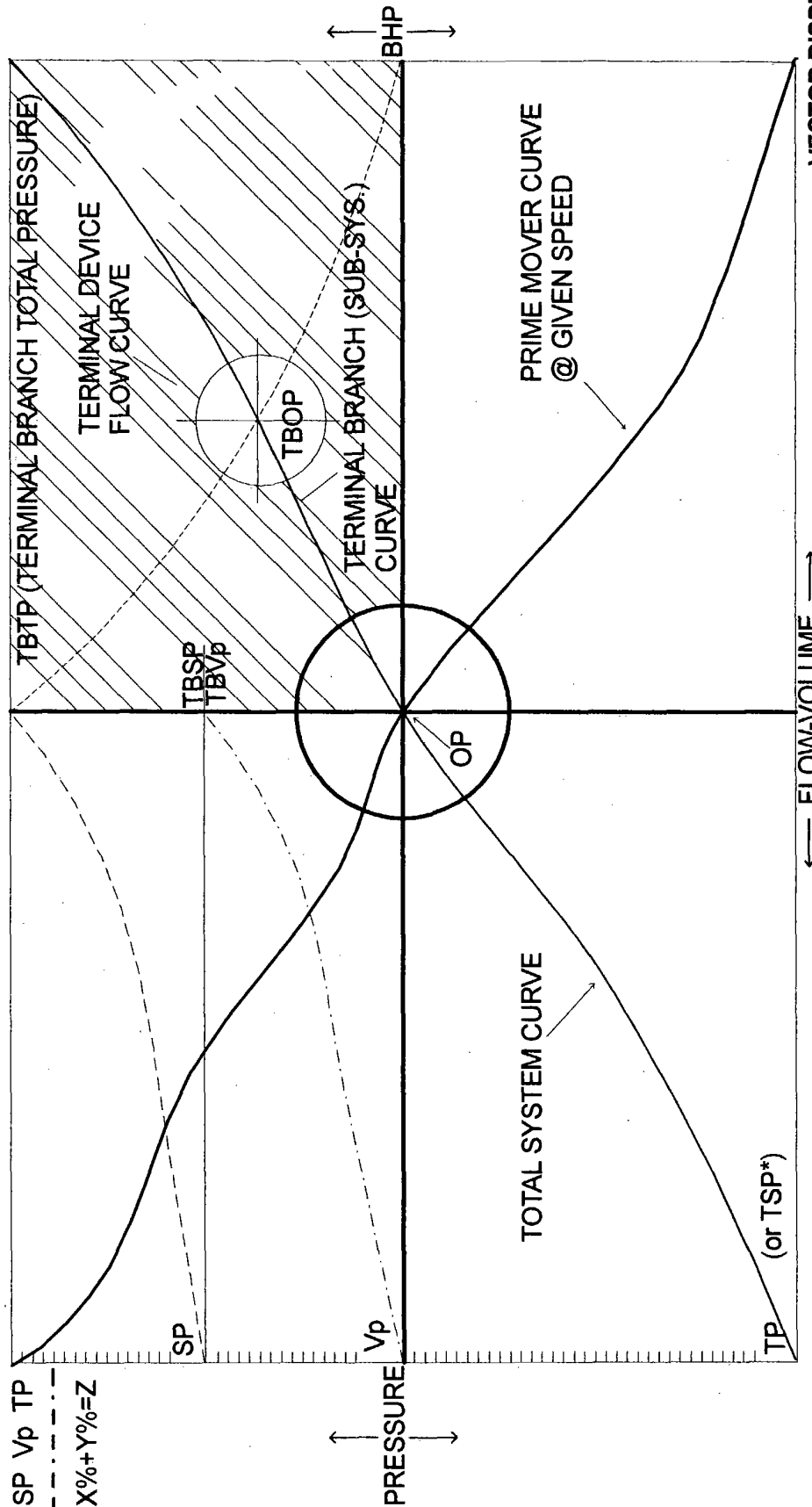
ENTERING AND LEAVING AIR TEMPERATURES IN COUNTER FLOW EXCHANGER

AIR-GAS-FLUIDS TO SAME
FLUIDS TO FLUIDS
GASES TO GASES
FLUIDS TO GASES, VICE VERSA
MIXTURES TO MIXTURES
(ALL OF THE ABOVE)

*VARIATIONS WOULD INCLUDE THE FOLLOWING IN ANY ARRANGEMENT, FORM, NUMBER, OR COMBINATION:

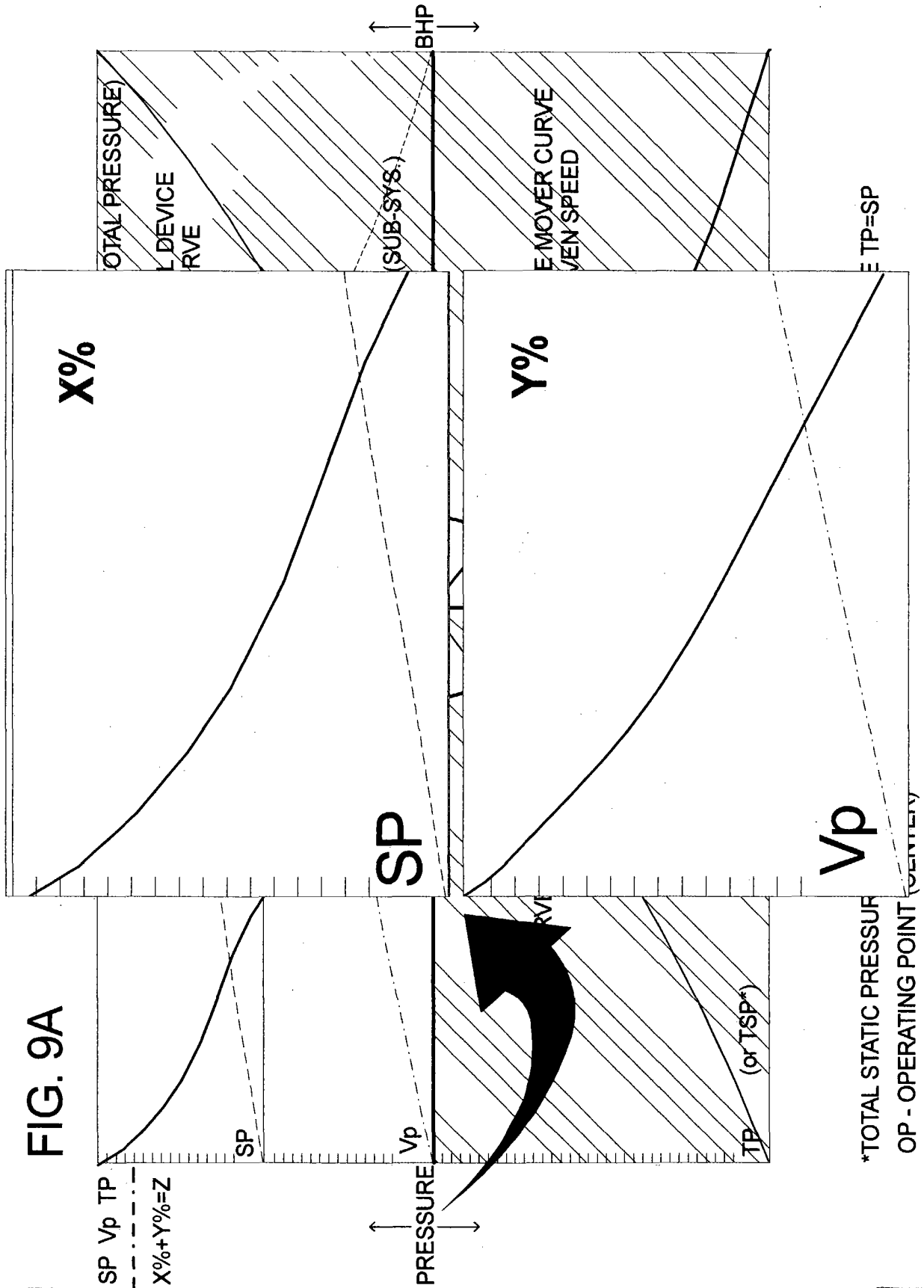
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FIG. 9 MAIN PANEL DISPLAY



*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE TP=SP
OP - OPERATING POINT (CENTER)

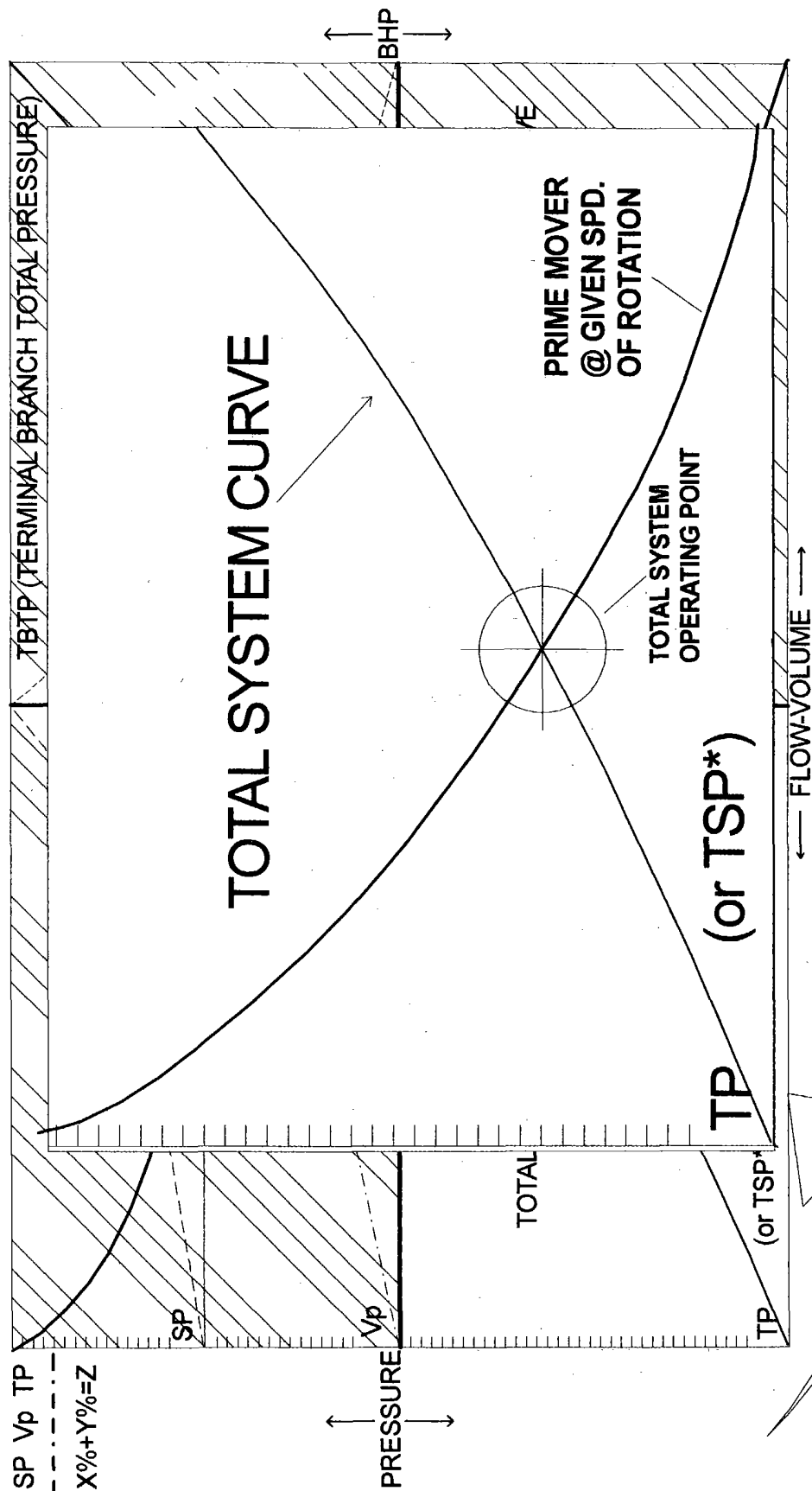
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*TOTAL STATIC PRESSURE
OP - OPERATING POINT (CENTER)

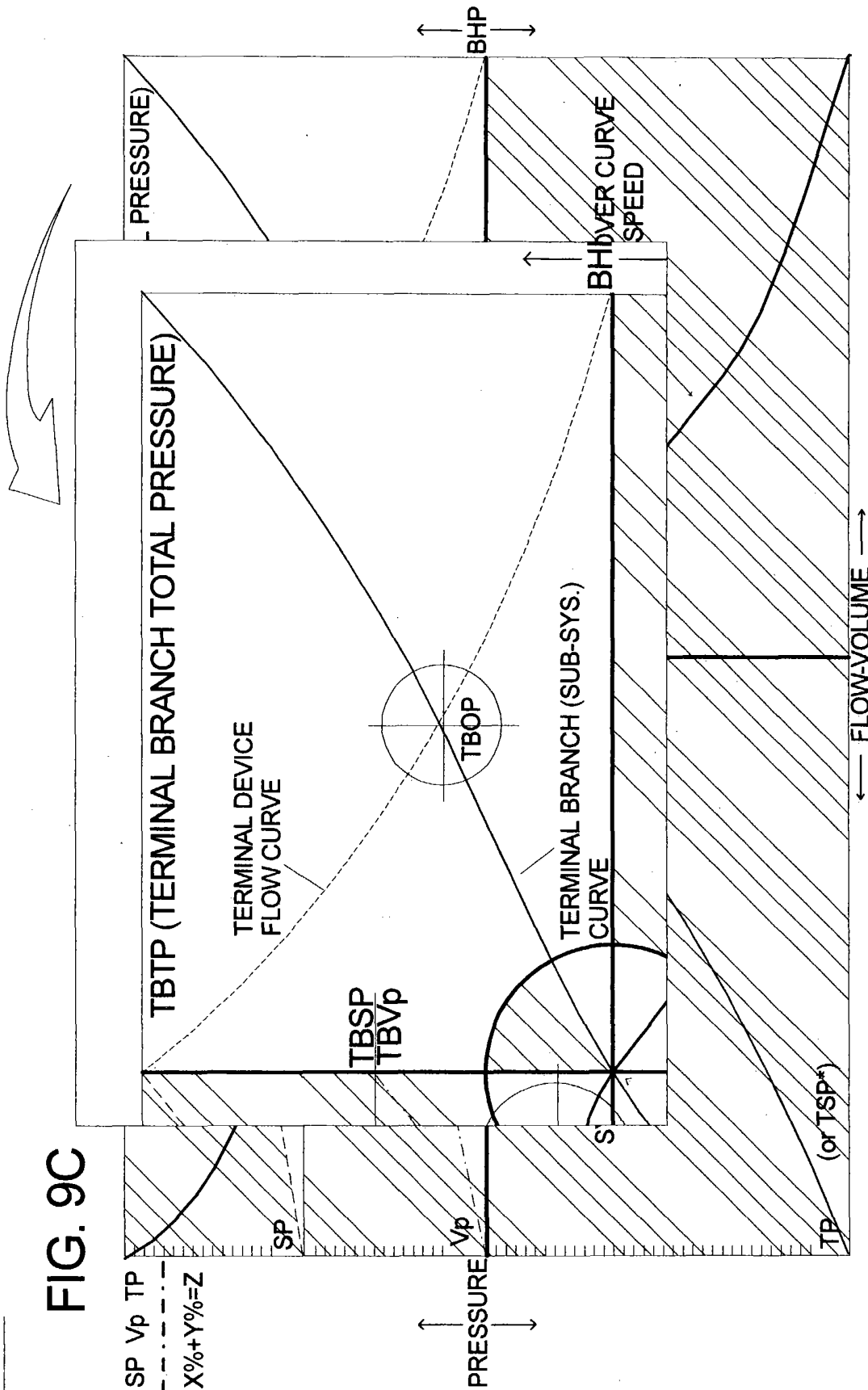
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FIG. 9B



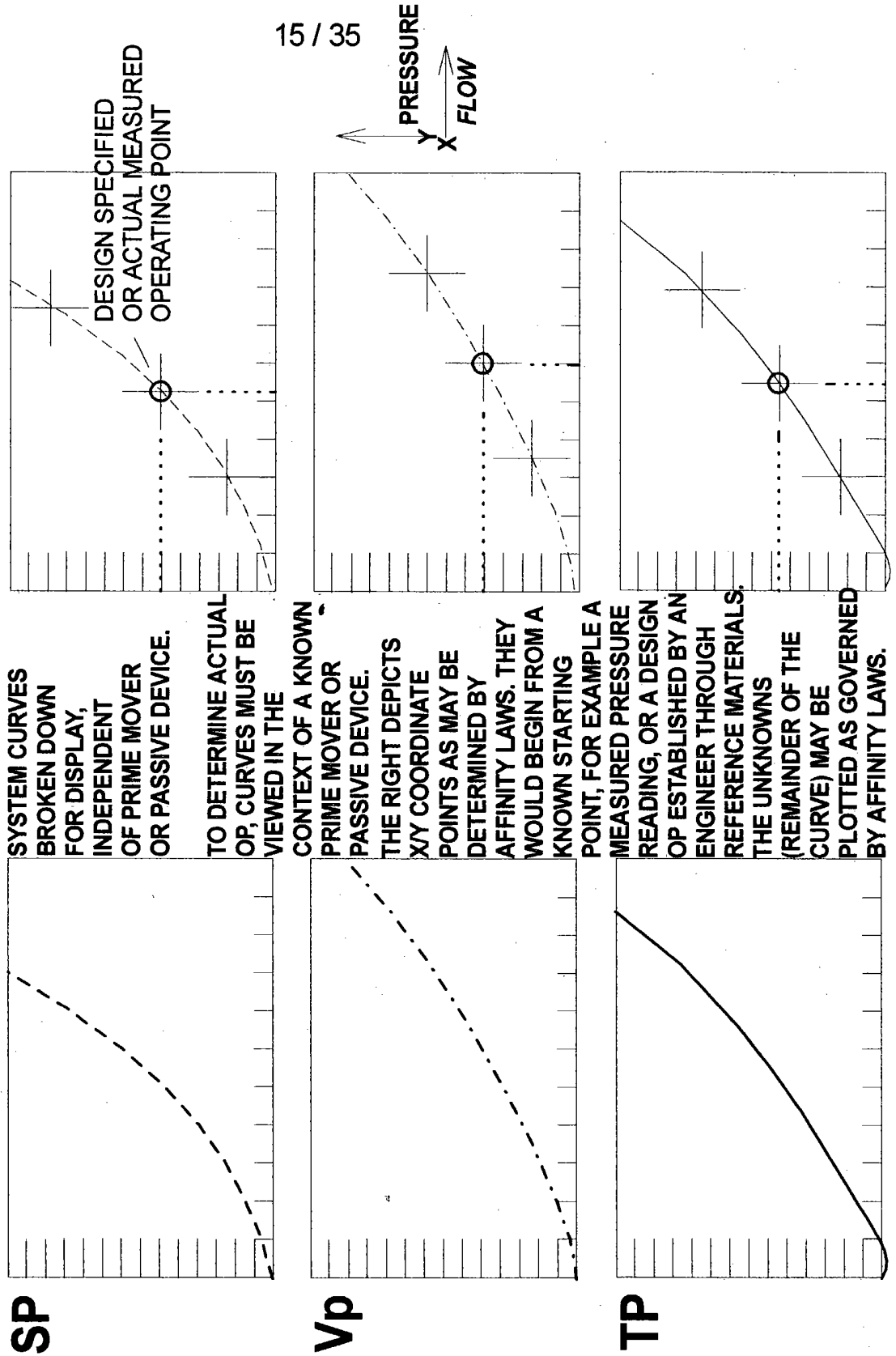
*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE TP=SP
OP - OPERATING POINT (CENTER)

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*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE TP=SP
OP - OPERATING POINT (CENTER)

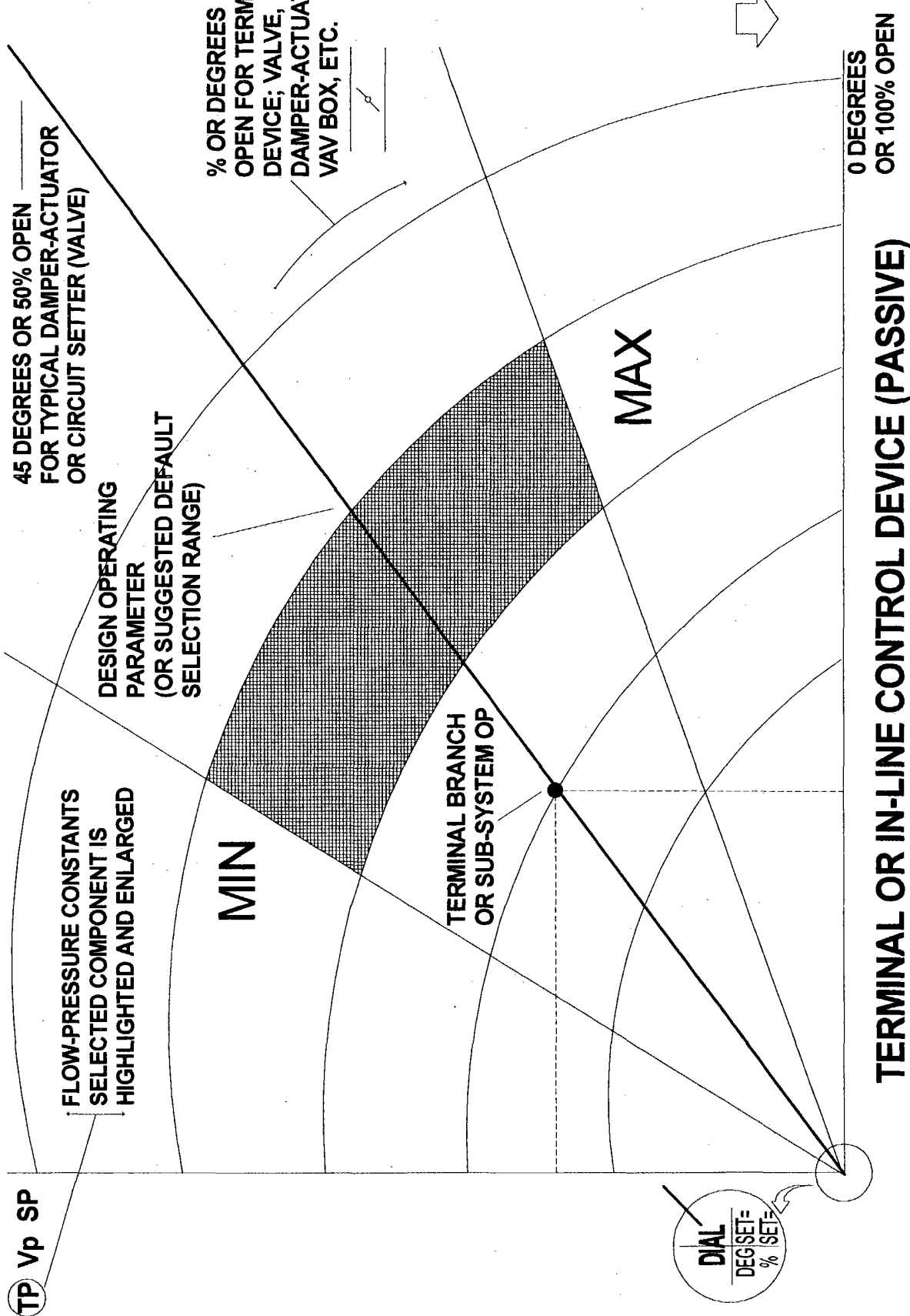
FIG. 10 3-PART SYSTEM CURVES VIEWED INDEPENDENTLY



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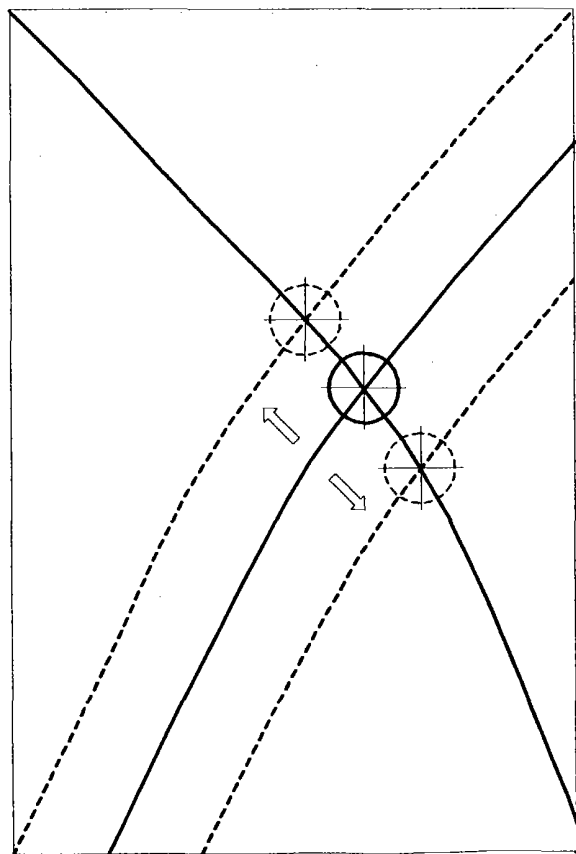
FIG. 11 TERMINAL DEVICE (WOC) WIDE OPEN CURVE

TP Vp SP



CURVE RIDING AND OP DEVIATION

FIG. 12



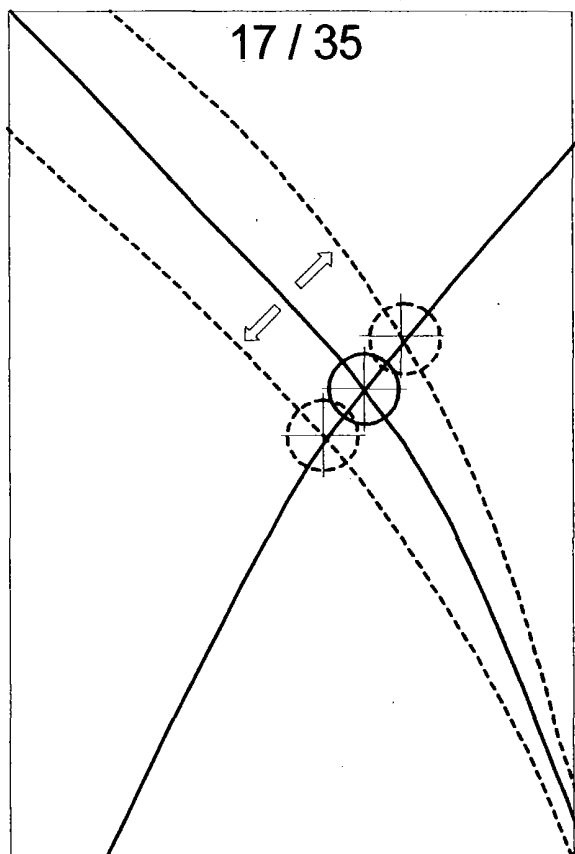
PRIME MOVER CHANGES

ROTATIONAL SPEED

SECONDARY MOVER

SERIES OR PARALLEL
OPERATION

FIG. 12A



SYSTEM CHANGES

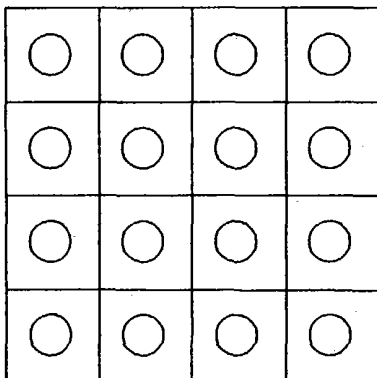
TP SP Vp

FIG. 13

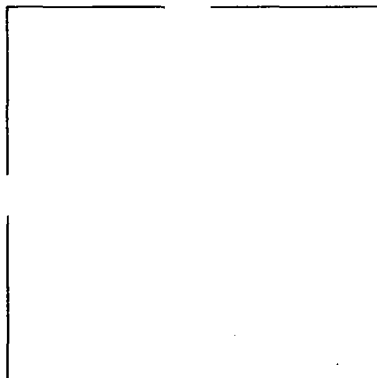
SENSOR LOGIC



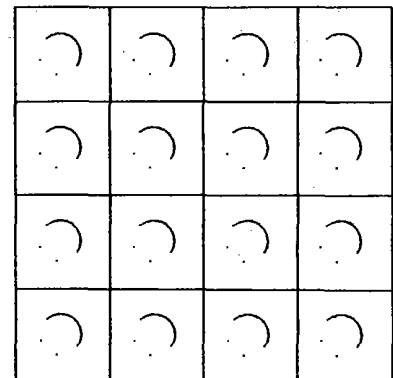
DUCT CROSS-SECTIONAL EQUAL AREA TRAVERSE



TOTAL IMPACT SENSORS



STATIC ONLY SENSORS



VELOCITY ONLY SENSORS
TP-SP, AS WITH PITOT TUBE

PRIME MOVER SENSOR LOGIC

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FIG. 14

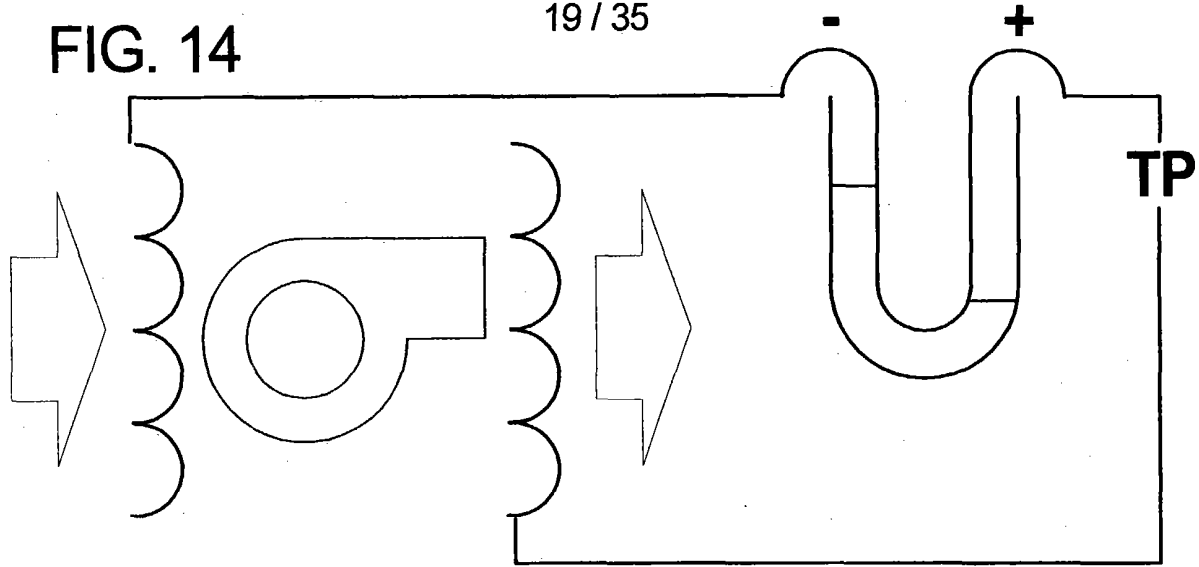


FIG. 14A

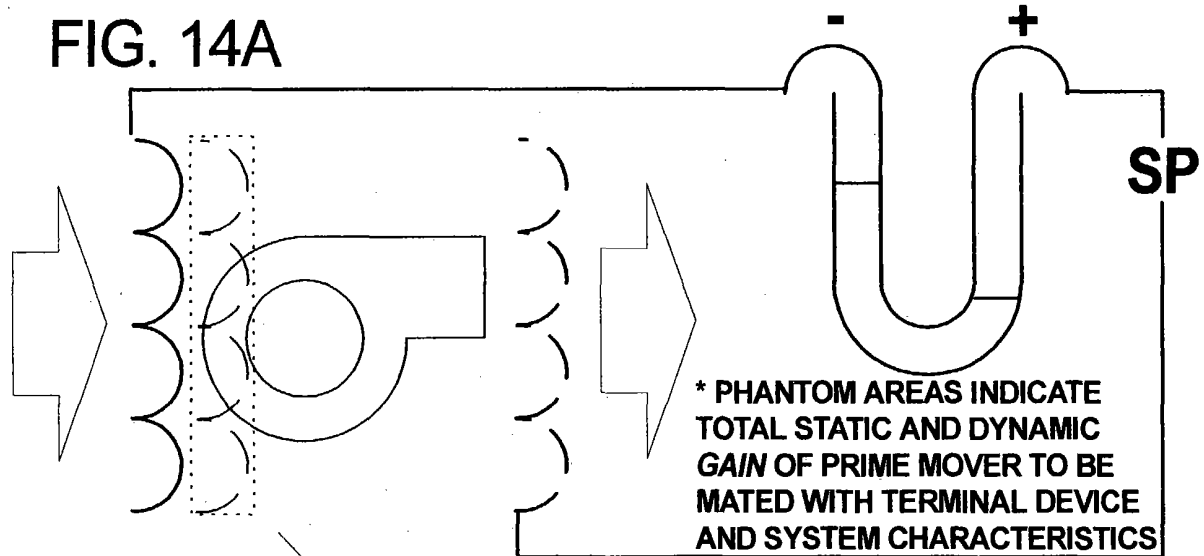
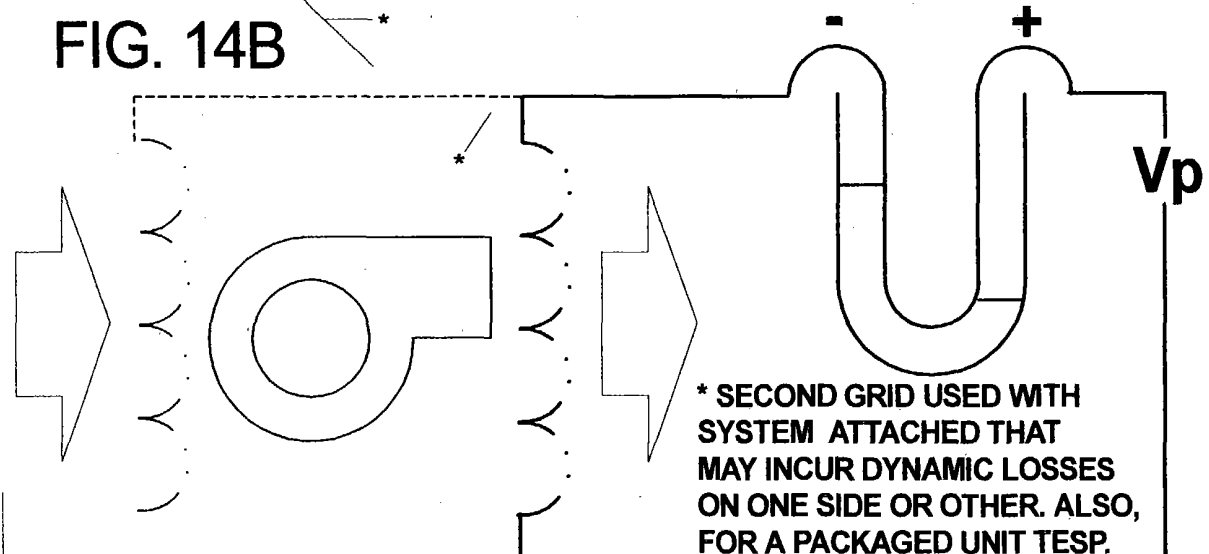


FIG. 14B

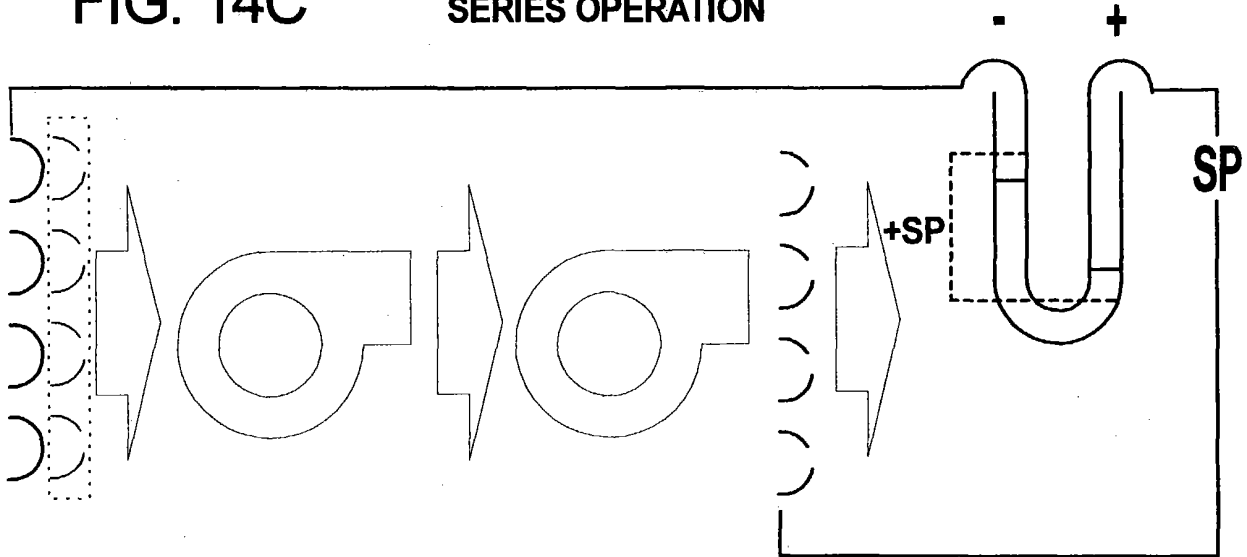


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MOVER SENSOR LOGIC IN SERIES OR PARALLEL OPERATION

FIG. 14C

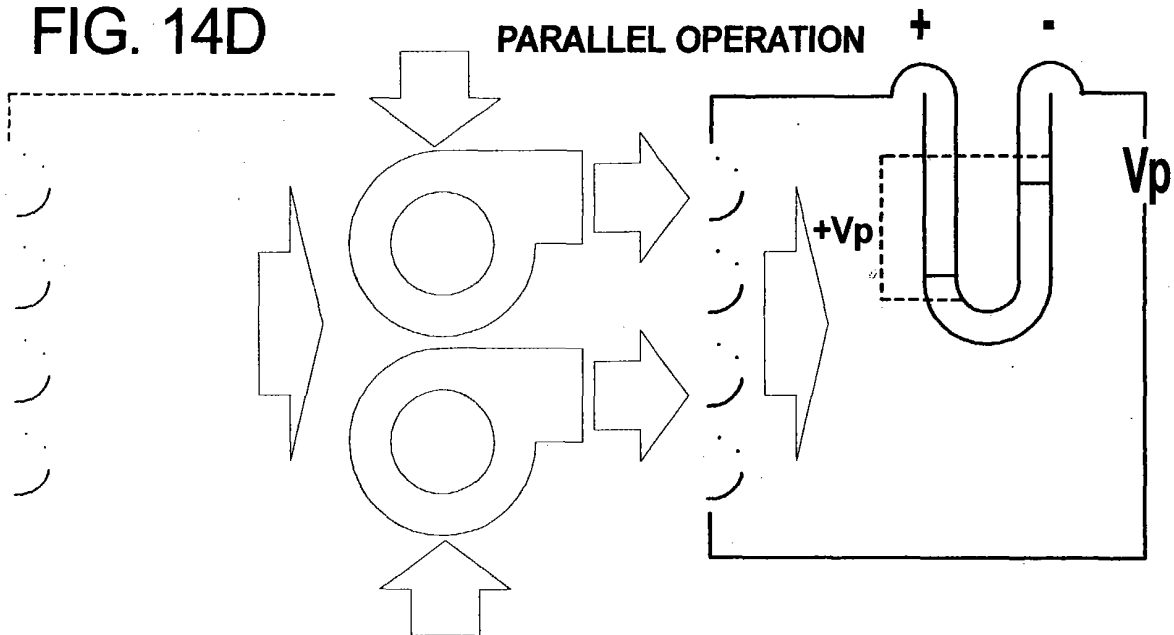
SERIES OPERATION



ONE OR MORE PRIMARY MOVERS IN SERIES OR PARALLEL
AUGMENT EITHER SP OR V_p , RESPECTIVELY, AS SHOWN.

FIG. 14D

PARALLEL OPERATION



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FIG. 15 **SENSOR LOGIC**

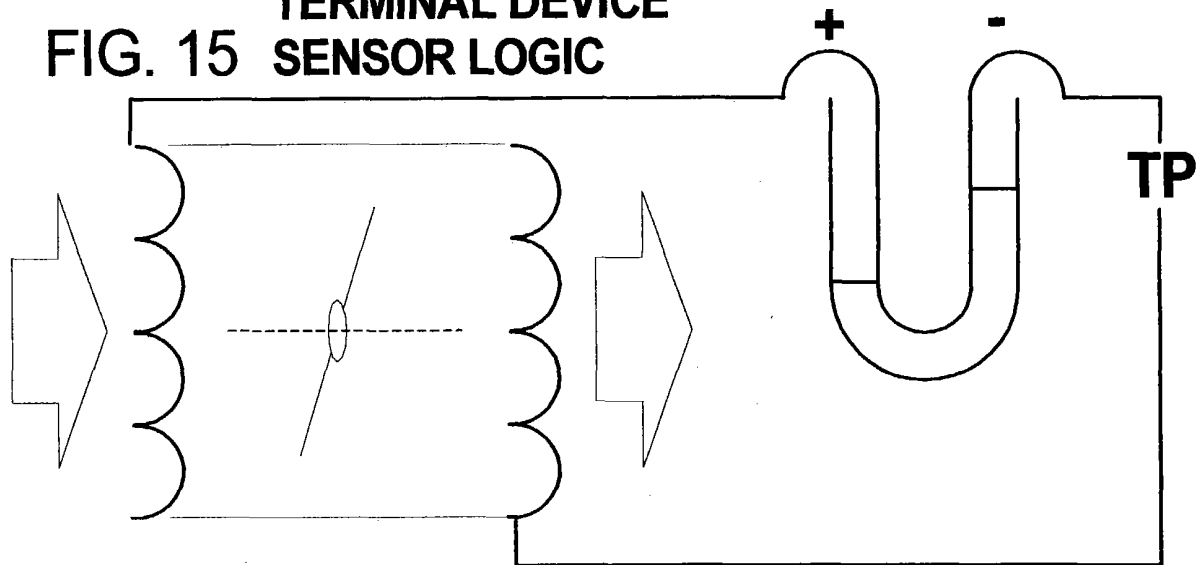


FIG. 15A

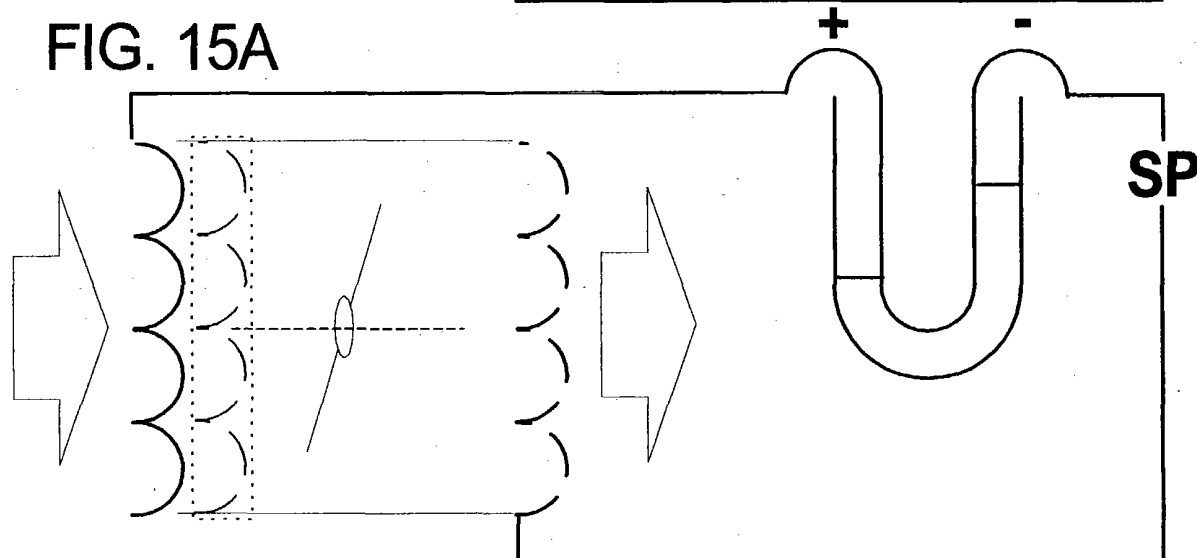
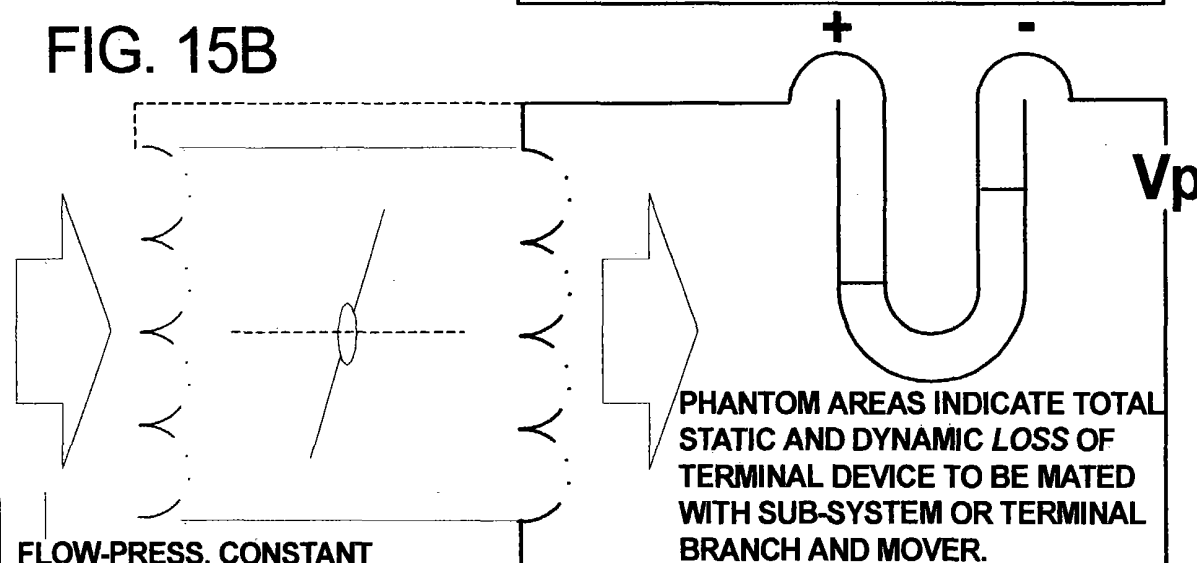


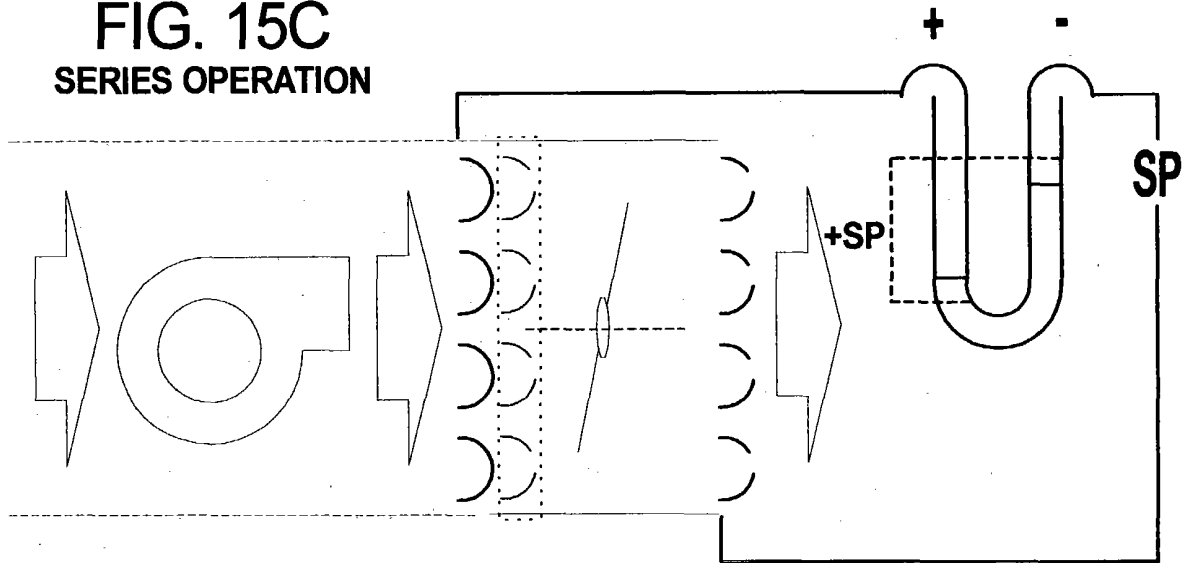
FIG. 15B



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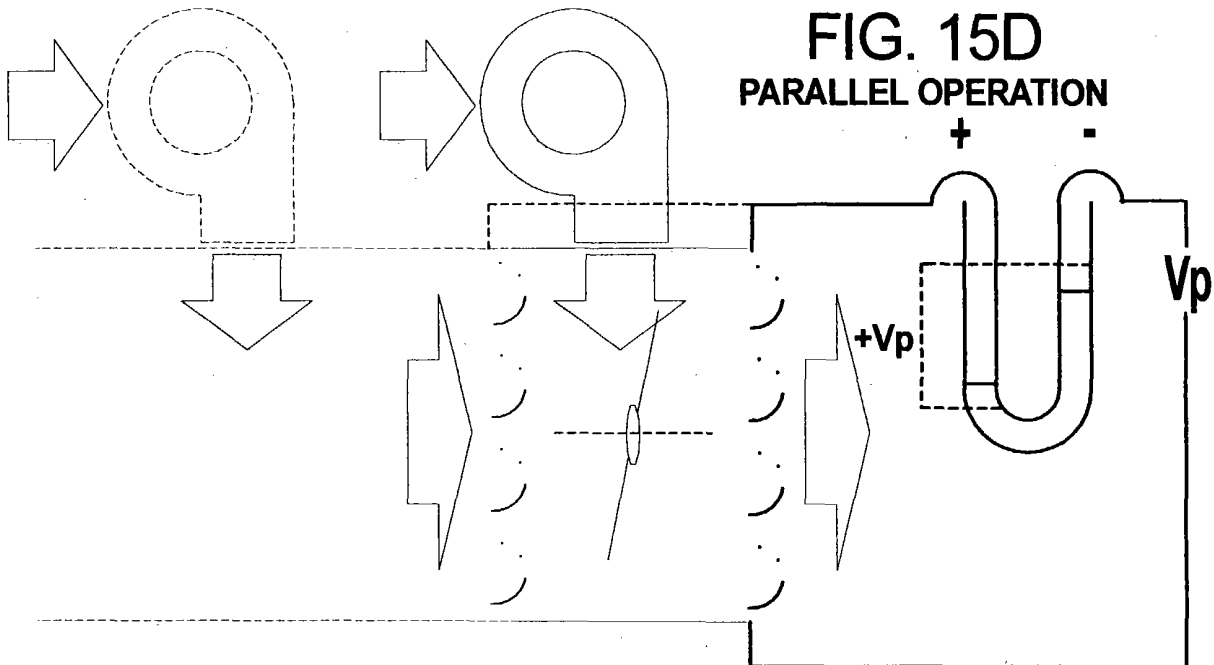
TERMINAL DEVICE SENSOR LOGIC WITH SECONDARY MOVER

FIG. 15C
SERIES OPERATION



ONE OR MORE SECONDARY MOVERS IN SERIES OR PARALLEL
AUGMENT EITHER SP OR V_p , RESPECTIVELY, AS SHOWN.

FIG. 15D
PARALLEL OPERATION



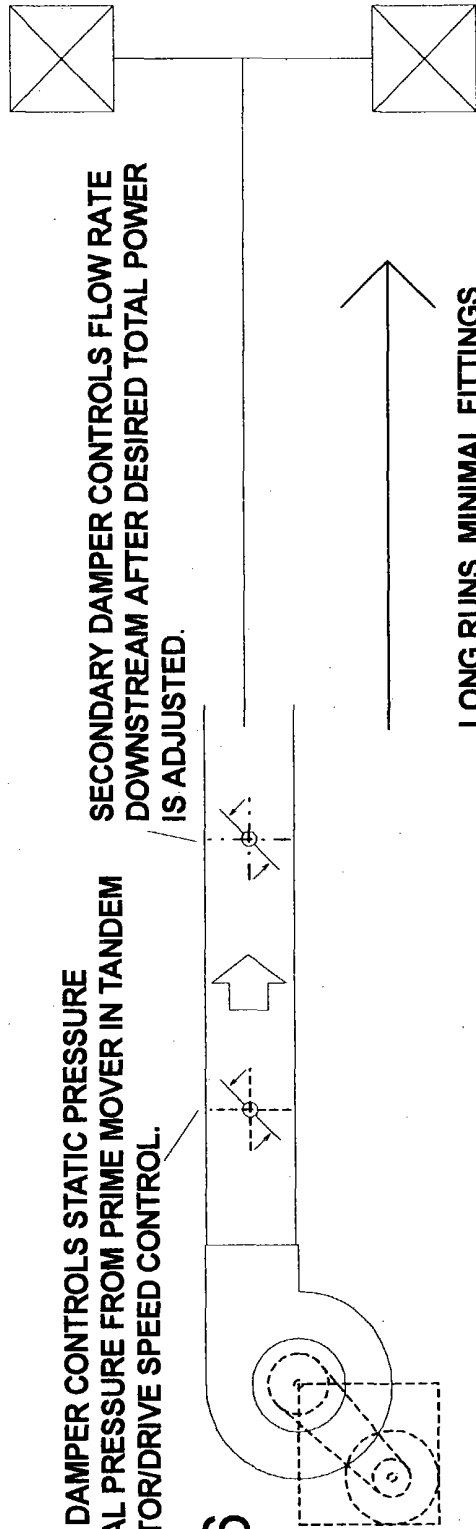
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DUAL DAMPER CONTROL IN SERIES AND PARALLEL

PRIMARY DAMPER CONTROLS STATIC PRESSURE AND TOTAL PRESSURE FROM PRIME MOVER IN TANDEM WITH MOTOR/DRIVE SPEED CONTROL.

SECONDARY DAMPER CONTROLS FLOW RATE DOWNSTREAM AFTER DESIRED TOTAL POWER IS ADJUSTED.

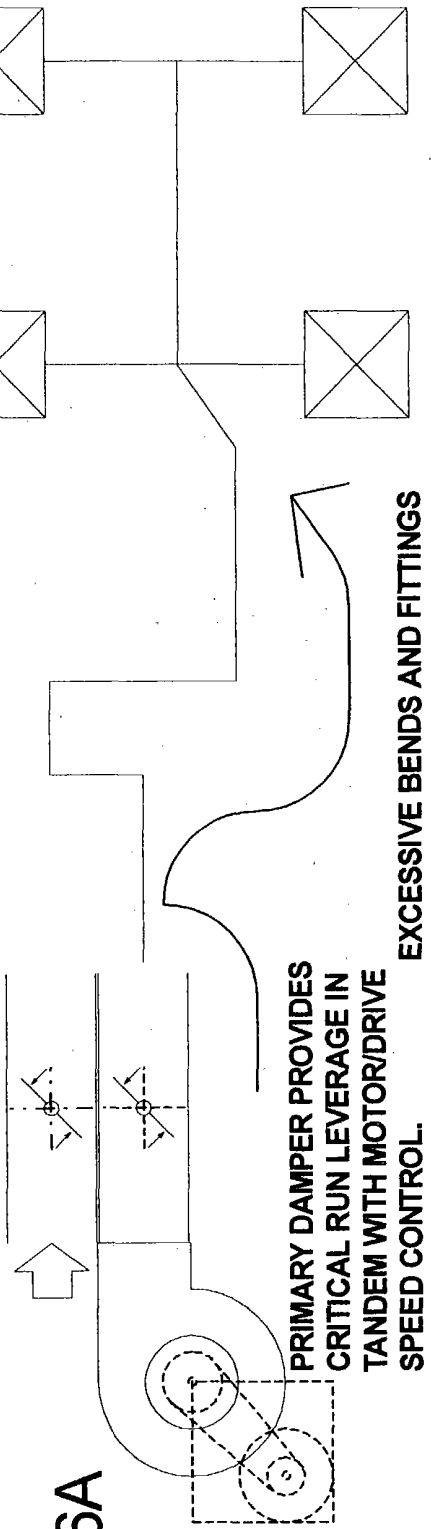
FIG. 16



PARALLEL DAMPER AND FLOW SOURCE PROVIDES CUMULATIVE VELOCITY TO TRAVERSE FITTING AND DIRECTIONAL LOSSES

LONG RUNS, MINIMAL FITTINGS

FIG. 16A

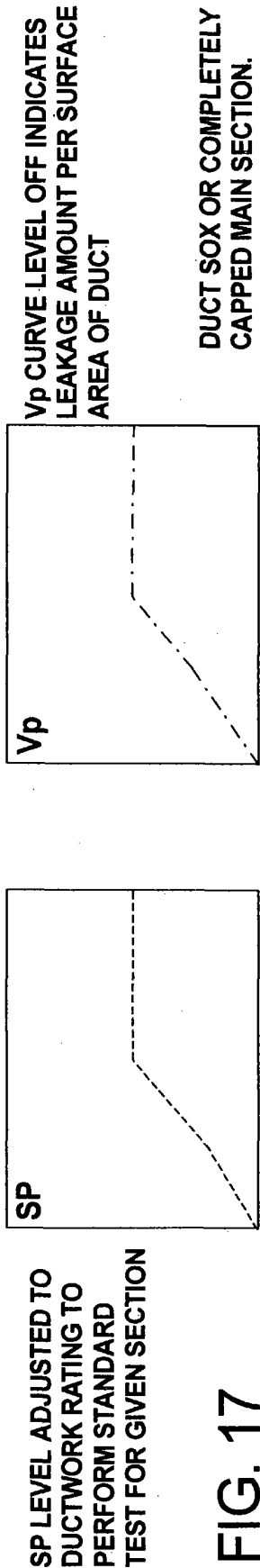


PRIMARY DAMPER PROVIDES CRITICAL RUN LEVERAGE IN TANDEM WITH MOTOR/DRIVE SPEED CONTROL.

EXCESSIVE BENDS AND FITTINGS

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LEAKAGE TESTER



DUCT SOX OR COMPLETELY CAPPED MAIN SECTION.

FIG. 17

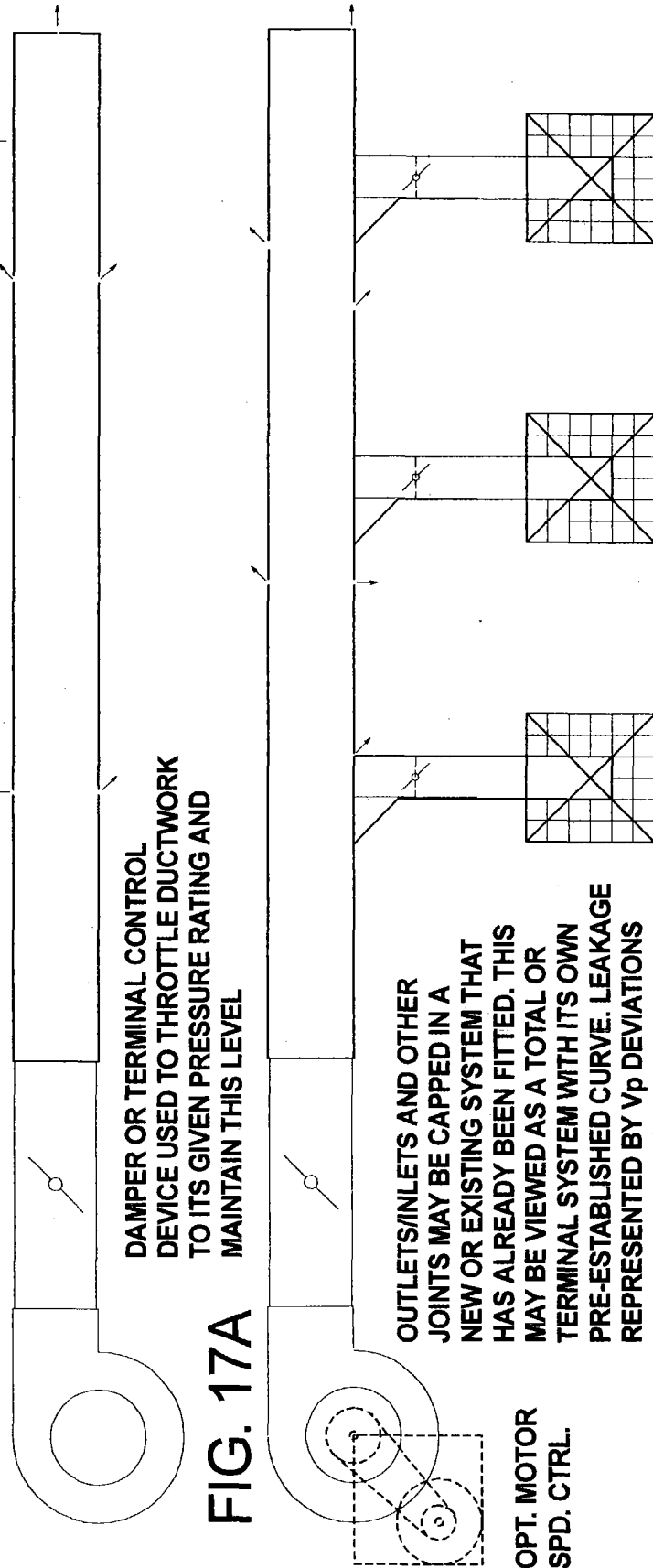


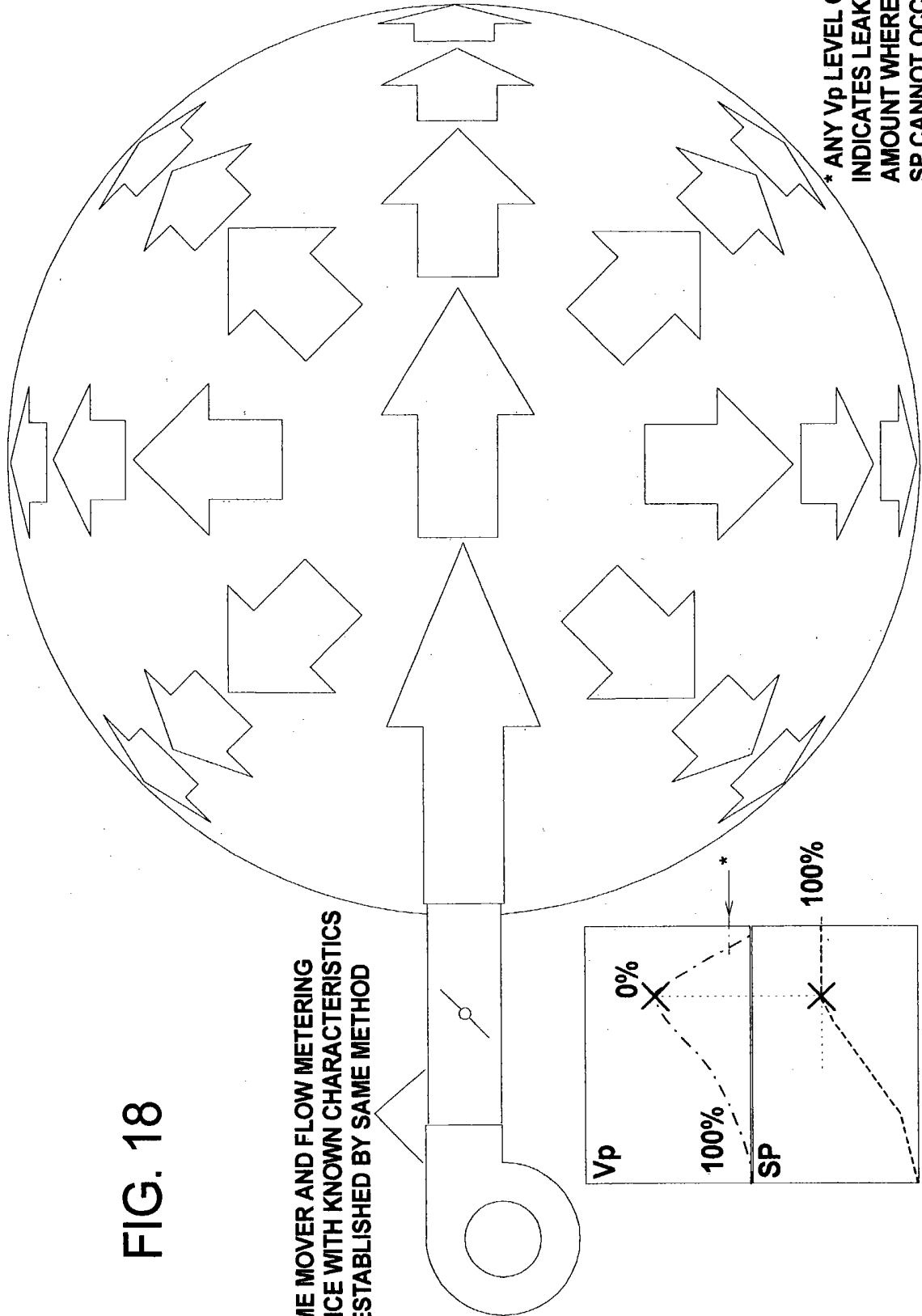
FIG. 17A

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VOLUME OF A GIVEN VESSEL OR ENCLOSURE

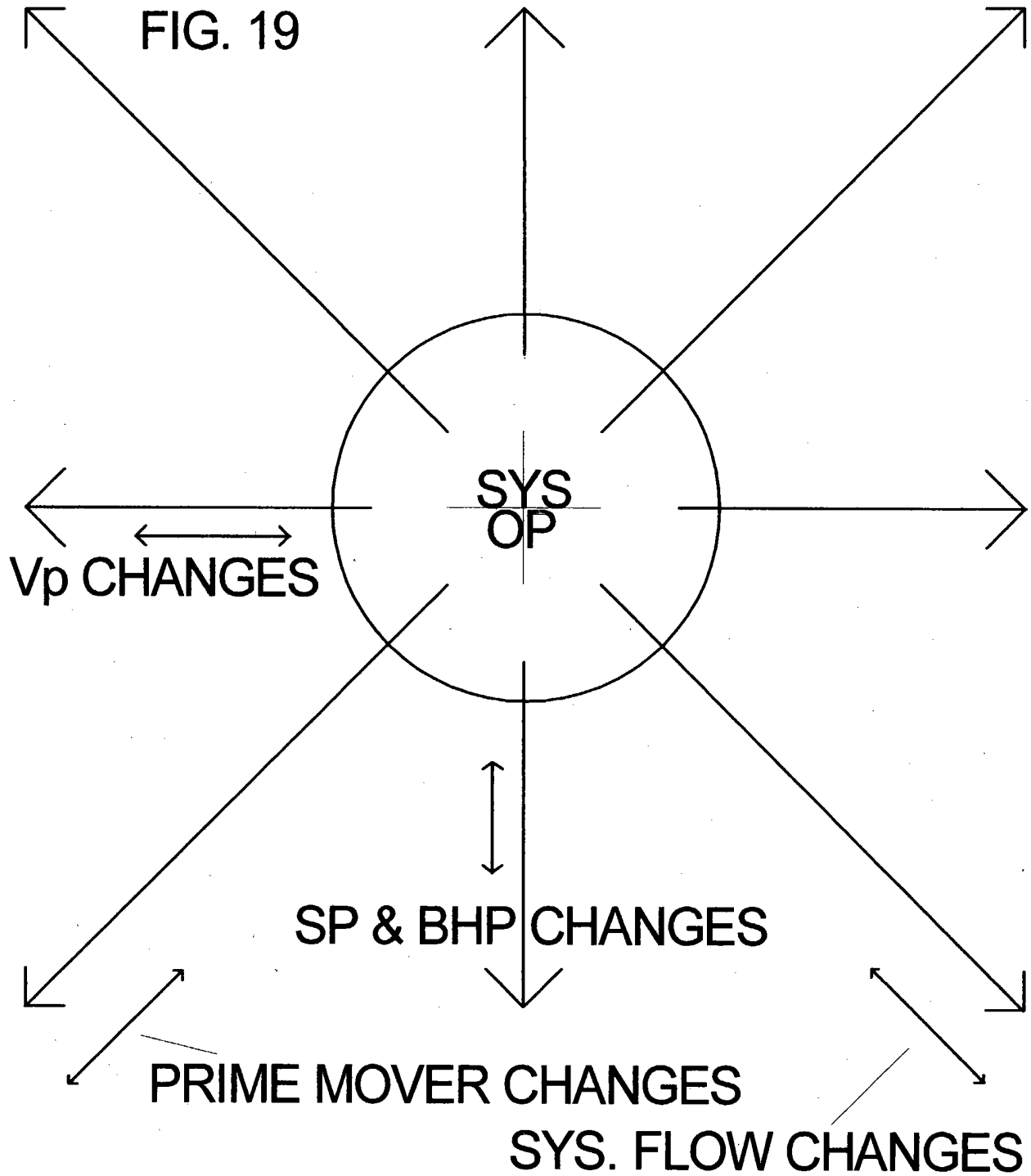
FIG. 18

PRIME MOVER AND FLOW METERING
DEVICE WITH KNOWN CHARACTERISTICS
AS ESTABLISHED BY SAME METHOD



* ANY V_p LEVEL OFF
INDICATES LEAKAGE
AMOUNT WHERE 100%
SP CANNOT OCCUR

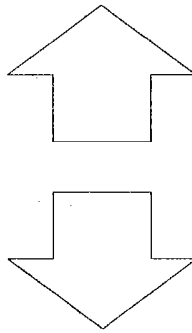
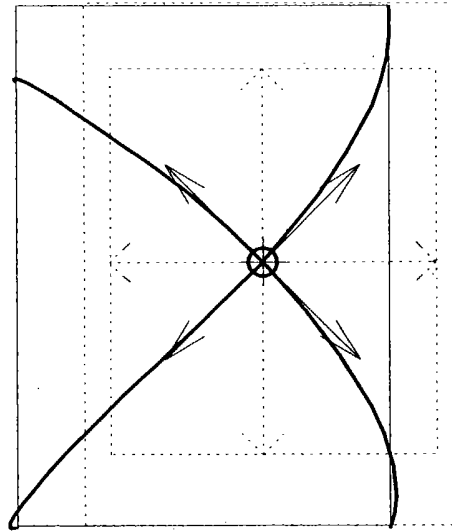
VECTORIAL DISPLAY



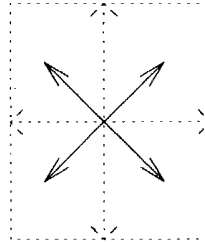
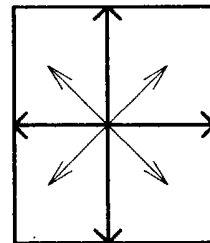
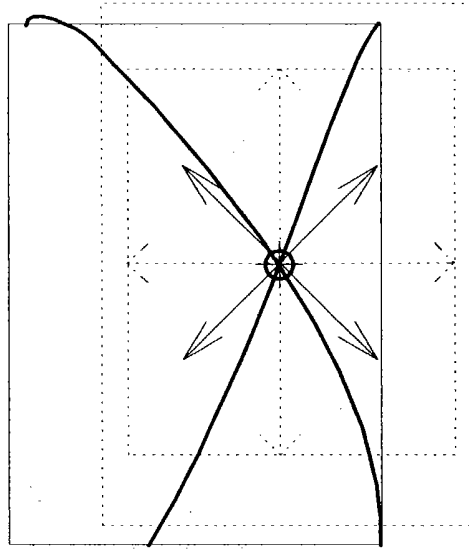
VECTORIAL ANALYSIS - TOTAL SYSTEM TO SUB-SYSTEM

FIG. 19A

TOTAL SYSTEM OP



TERMINAL BRANCH OP



SWITCH TO OR FROM MAIN
VECTORIAL DISPLAY SCREEN
REFER TO FIG. 9

SHOWN HERE, A CORRELATIVE EFFECT BETWEEN A TOTAL SYSTEM AND ITS SUB-BRANCH AS THE CHANGE IN ONE AFFECTS THE OTHER, EITHER ADVERSELY OR BENEFICIALLY. THE VECTIORIAL ANALYSIS PROVIDES A "BARE BONES" DEPICTION OF EACH SPECIFIC CHANGE EFFECTED IN ONE OR THE OTHER SYSTEM. FOR EXAMPLE, THERE WAS AN X INCREASE IN BHP WHEN A DAMPER WAS CLOSED IN THE SUB-BRANCH.

FIG. 20

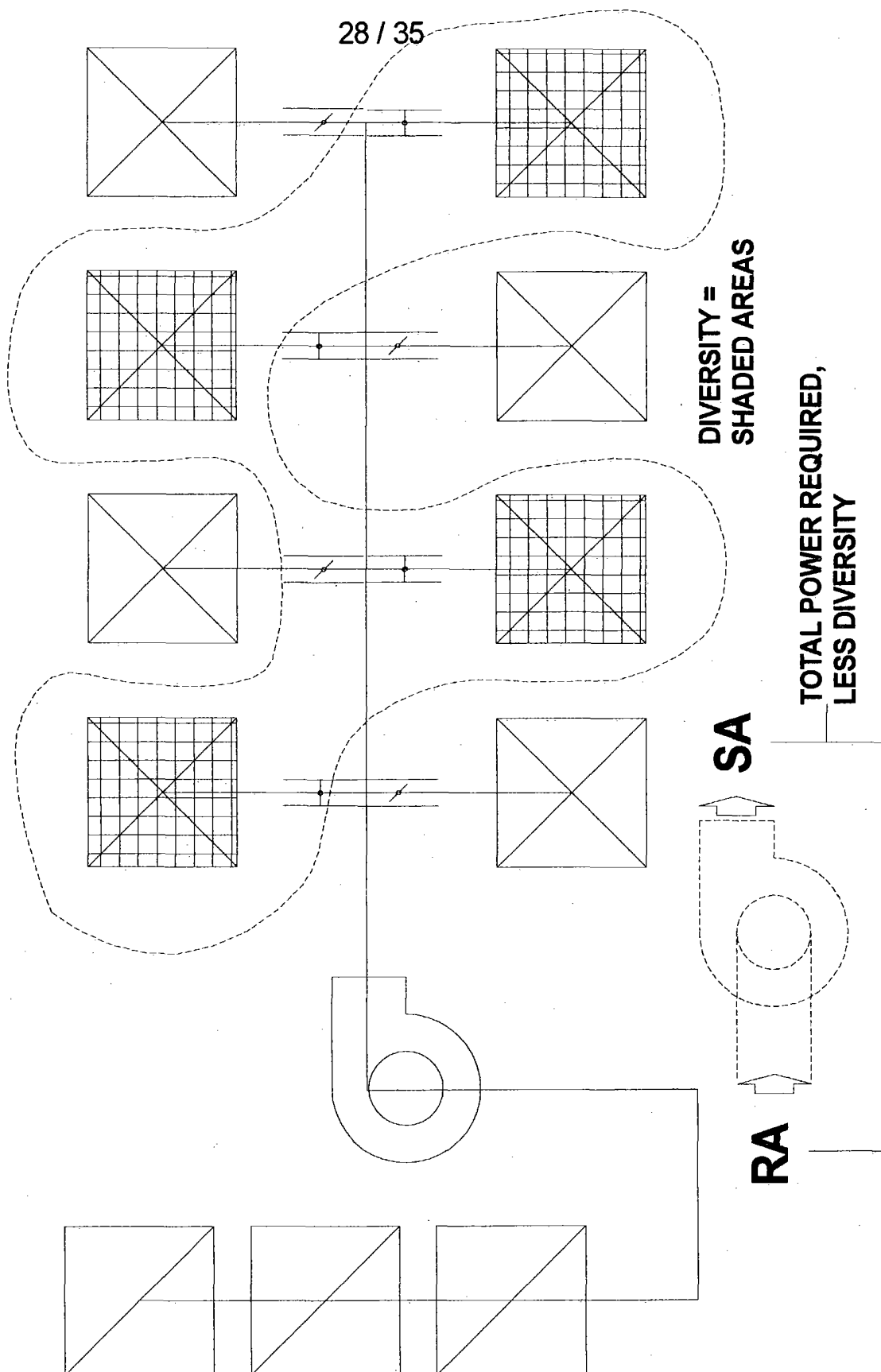


FIG. 21

MAIN MENU DISPLAY

AIR SYSTEMS (HVAC, NON-HVAC)

HYDRONIC SYSTEMS

FLUIDIC SYSTEMS

GASEOUS SYSTEMS

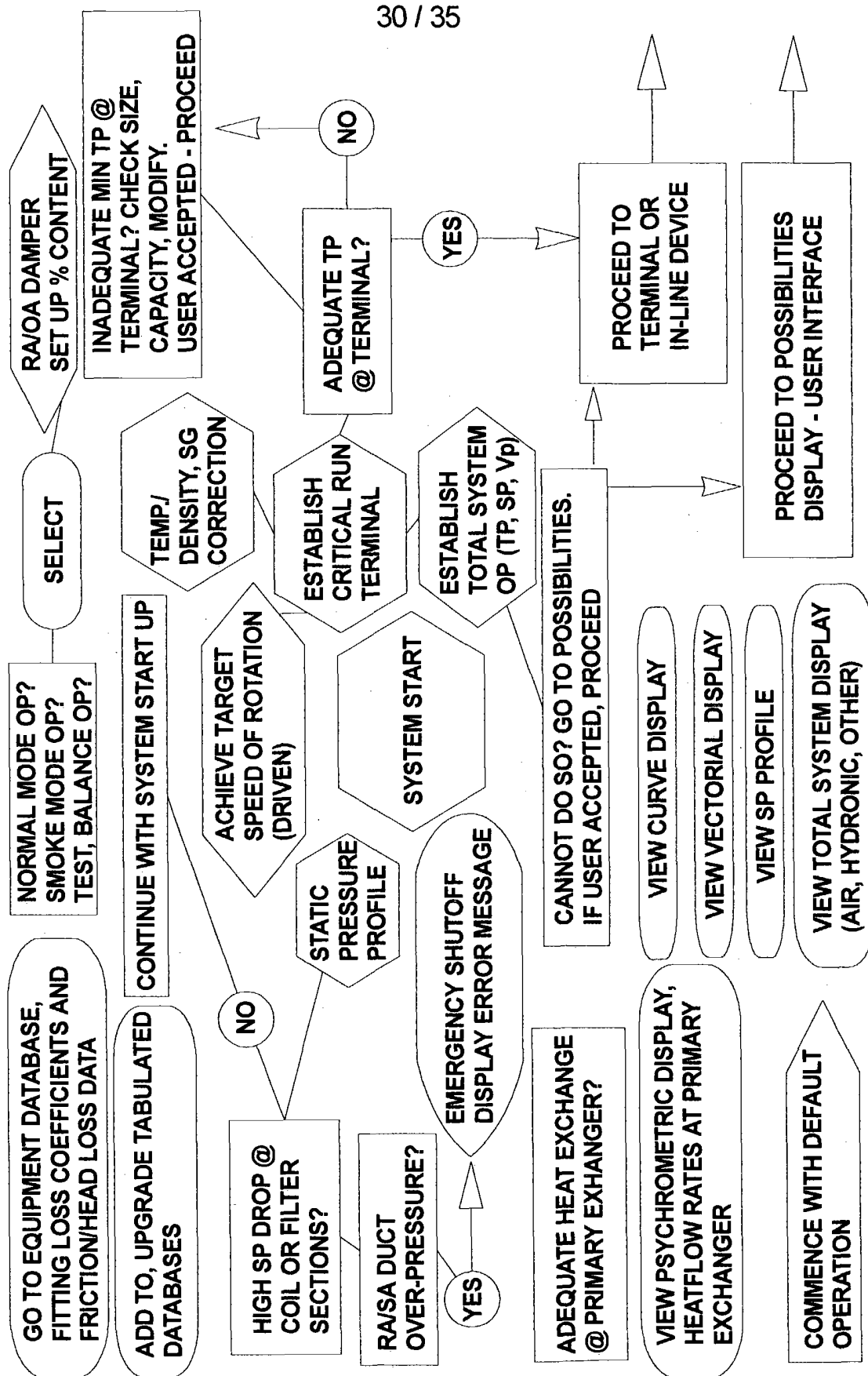
MIXTURES

**VIEW
MAIN
OP CURVE
DISPLAY**

**ENABLE
DEFAULT
OPERATION**

**SYSTEM
START**

FIG. 22



SYSTEM START FLOW CHART (HYDRONICS)

FIG. 22A

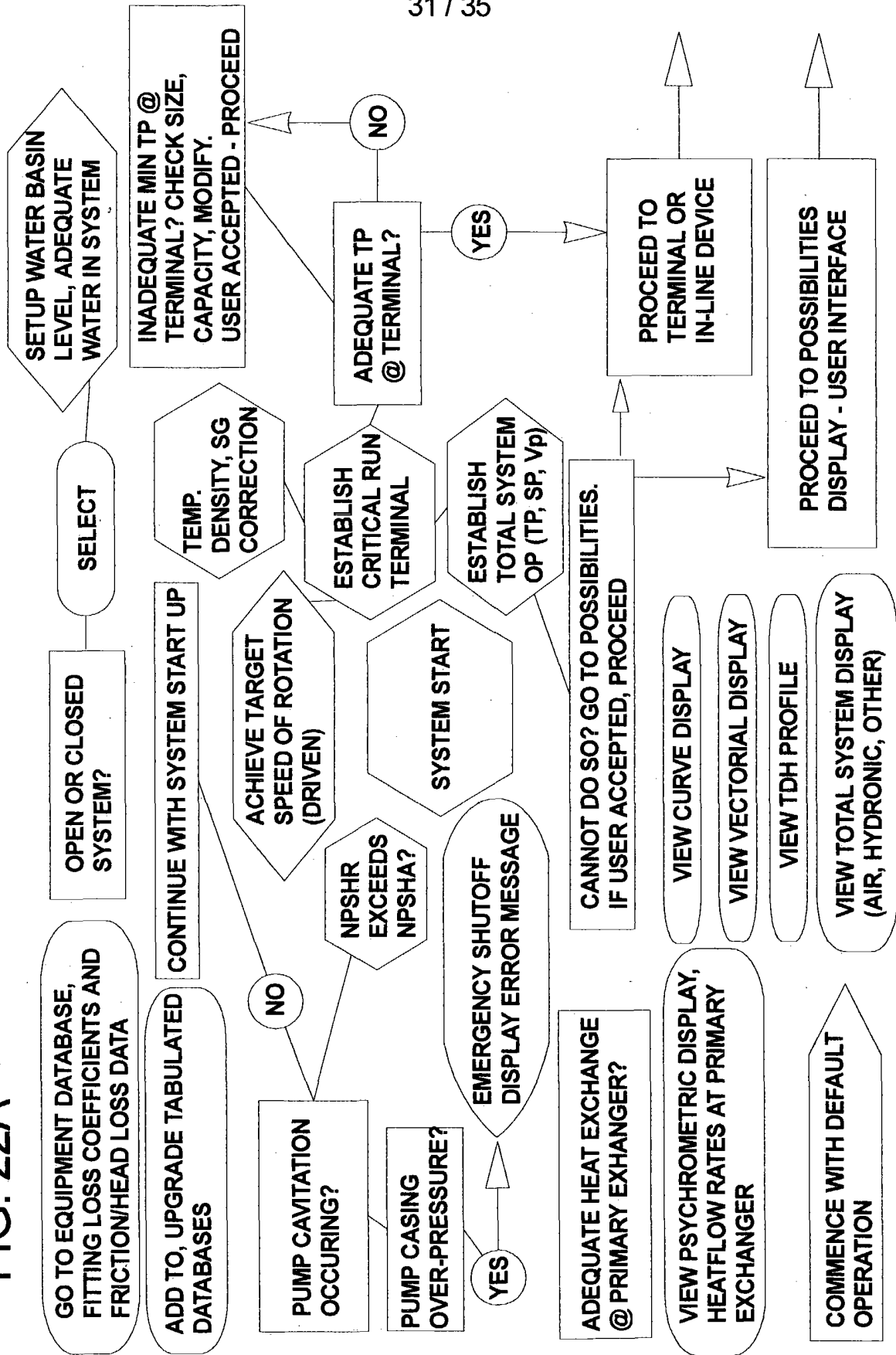
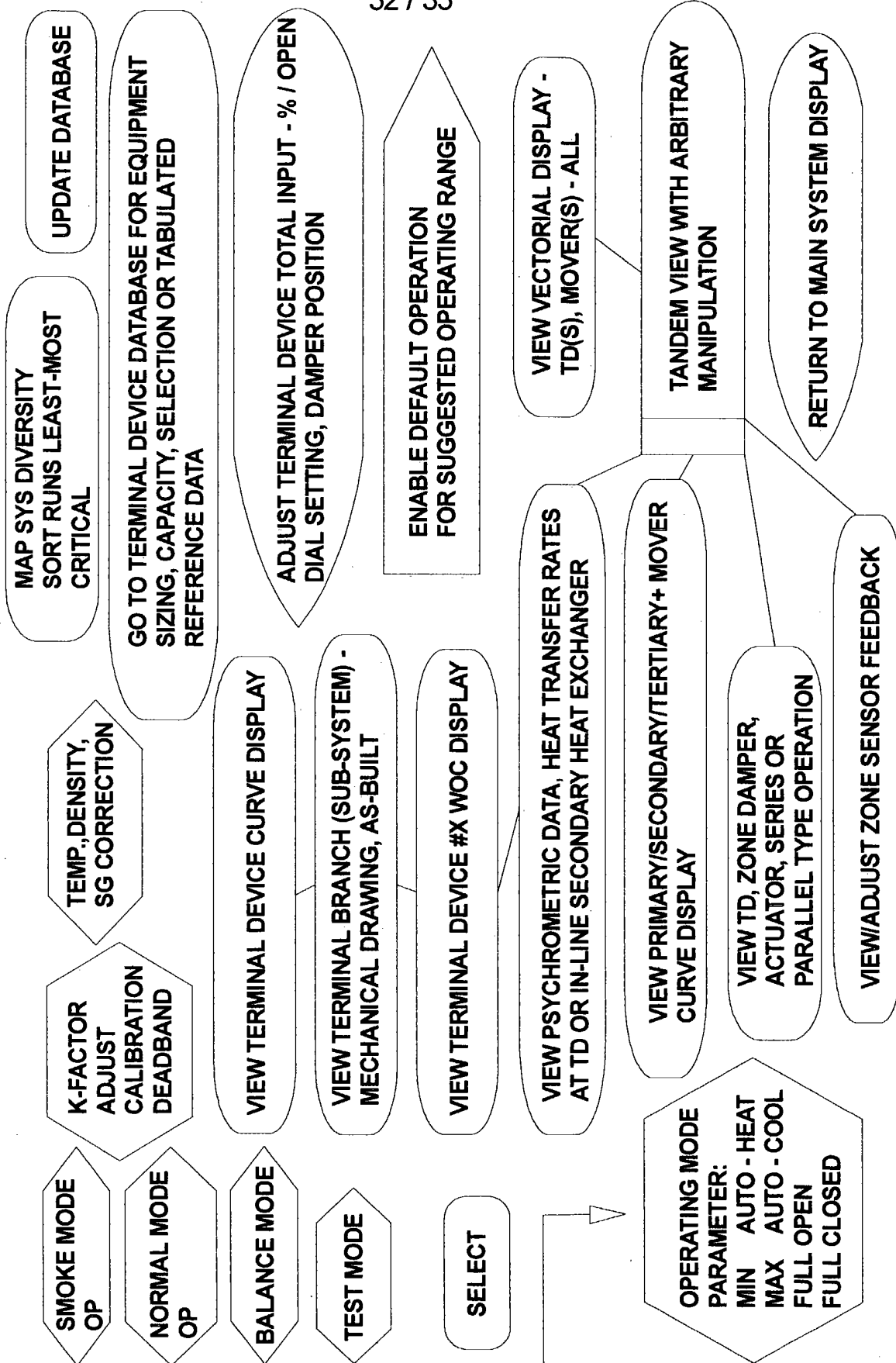


FIG. 22B

TERMINAL DEVICE FLOW CHART



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FIG. 22C POSSIBILITIES DISPLAY MENU (AIR)

VERIFY THAT THE FOLLOWING CONDITIONS HAVE BEEN MET:

IS THE SYSTEM IN THE CORRECT MODE OF OPERATION?

NORMAL, SMOKE, BALANCE, OR TEST MODE OF OPERATION

ARE ALL DAMPERS/VALVES/TD'S FULLY OPEN OR IN THEIR MAX DESIGN POSITIONS (LESS DIVERSITY) THROUGHOUT THE SYSTEM FOR NORMAL, SMOKE, TESTING, OR BALANCING MODE START UP?

IS MOVER ROTATION CORRECT? MAY REQUIRE PHASE CHANGE

VERIFY THAT MOTOR/DRIVE DATA, TAG, STOCK INFO. IS CORRECT OR APPLY DEFAULT SEARCH OF DATABASE FOR SUITABLE RECOMMENDATION NEEDED TO ACHIEVE OP UNDER CURRENT AS-BUILT CONDITIONS

RA/OA, ECONOMIZER, OR OTHER INTERNAL DAMPERS SET CORRECTLY
NORMAL OR OTHER MODE OPERATION - % RA/OA

CHECK PACKAGE HOUSING, BLOWER CABINET FOR OBSTRUCTIONS PROBLEM ORIGINATES FROM...?

CLEAN, REPLACE FILTERS

CLEAN COIL FINS, COIL INTERIOR

CHECK REFRIGERANT PRESS./TEMP. IN/OUT

CHECK EXPANSION/CONDENSATION CYCLE,
HI/LO CUTOUPS, EXPANSION VALVE

SMOKE MODE OPERATION

ARE ALL SMOKE DAMPERS OPEN?

NORMALLY CLOSED / OPEN (WITHOUT POWER)

IS OA DAMPER FULLY OPEN? (100% OA)

IS RA DAMPER FULLY CLOSED? (0% RA)

GO TO MOTOR/DRIVE DATABASE
(NOT INDEPENDENT OF MOVER)

GO TO SEARCHABLE DATABASE

ADD TO, UPGRADE
POSSIBILITY DATABASE

TRY SYSTEM RESTART

PROBLEM(S) REMAIN
RETURN TO POSS
INTERFACE

EXTERNAL PROBLEM:

PROBLEM AT PRIME

MOVER SUCTION,

DISCHARGE?

@ FLOW SENSOR

GRID?

@ TERMINAL OR IN-LINE
DEVICE?

@ SMOKE DAMPER ON

WALL PARTITION

DUCT SMOKE DETECTOR

OTHER EXTERNAL

DEVICE

INTERNAL PROBLEM:

MIXING BOX

FILTER SECTION(S) -

FORE / AFT OF MOVER

COIL SECTION(S)

BLOWER SECTION

HUMIDIFIER / UV

OTHER SECTION

TEMP./HEAT EXCHANGE
PROBLEM

FIG. 22D POSSIBILITIES DISPLAY MENU (HYDRONICS)

VERIFY THAT THE FOLLOWING CONDITIONS HAVE BEEN MET:

IS THE SYSTEM AN OPEN OR CLOSED SYSTEM?

IS THE SYSTEM IN THE CORRECT MODE OF OPERATION?

ARE ALL VALVES/TD'S FULLY OPEN OR IN THEIR MAX DESIGN POSITIONS (LESS DIVERSITY) THROUGHOUT THE SYSTEM FOR NORMAL, TESTING, OR BALANCING MODE START UP?

IS MOVER ROTATION CORRECT? MAY REQUIRE PHASE CHANGE

VERIFY THAT MOTOR/DRIVE DATA, TAG, STOCK INFO. IS CORRECT OR APPLY DEFAULT SEARCH OF DATABASE FOR SUITABLE RECOMMENDATION NEEDED TO ACHIEVE OP UNDER CURRENT AS-BUILT CONDITIONS

OPEN SYSTEM

DOES THE SYSTEM HAVE SUCTION LIFT, I.E., PIPING BELOW PUMP CENTERLINE?

DOES THE SYSTEM HAVE ADEQUATE NPSH?

IS WATER BASIN LEVEL BEING MAINTAINED?

IS THERE ADEQUATE MAKEUP WATER?

IS THERE ADEQUATE WATER IN THE SYSTEM AT HIGHEST POINT IN PIPING?

CLOSED SYSTEM

IS THERE ADEQUATE WATER IN THE SYSTEM AT HIGHEST POINT IN PIPING?

HYDRONICS TERMINAL COIL PROBLEM:

COIL CHW IN HAS CORRECT TEMP., BUT NO FLOW/TEMP. SENSED CHW OUT? AERATE COIL

GO TO MOTOR/DRIVE DATABASE (NOT INDEPENDENT OF MOVER)

GO TO SEARCHABLE DATABASE

ADD TO, UPGRADE POSSIBILITY DATABASE

TRY SYSTEM RESTART

PROBLEM(S) REMAIN RETURN TO POSS INTERFACE

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PROBLEM ORIGINATES FROM...?

EXTERNAL PROBLEM:

PROBLEM AT PRIME

MOVER SUCTION,

DISCHARGE?

@ FLOW SENSOR

GRID?

@ TERMINAL OR IN-LINE

DEVICE?

OTHER EXTERNAL

DEVICE

INTERNAL PROBLEM:

PUMP CASING

IMPELLER

STRAINER SECTION(S)

FORE / AFT OF MOVER

OTHER INT. SECTION

TEMP/HEAT EXCHANGE PROBLEM

INDEPENDENT SYSTEM CURVES (PRESSURE / HEAD)

FIG. 23

